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(21) International Application Number: PCT/US92/02510 (22) International Filing Date: 1 April 1992 (01.04.92) (30) Priority data: 678,063 1 April 1991 (01.04.91) US (71) Applicant: PI ELECTRONICS INCORPORATED [US/ US]; 9777 West Gulf Bank Road #5, Houston, TX 77040-3113 (US). (72) Inventors: GIL, Asher ; 5922 Pine Arbor, Houston, TX 77066 (US). DARON, John, B. ; 9006 Arbor Wood, Houston, TX 77040 (US). (74) Agent: TOEDT, D., C., III; Arnold, White & Durkee, P.O. Box 4433, Houston, TX 77210 (US).		(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (Eu- ropean patent), GN (OAPI patent), GR (European pa- tent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC (European patent), MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, RU, SD, SE, SE (Euro- pean patent), SN (OAPI patent), TD (OAPI patent), TG (OAPI patent). Published With international search report.
(54) Title: AUTOMATED SELF-SERVICE PACKAGE SHIPPING MACHINE		
(57) Abstract A self-service apparatus (100) capable of au- tomatically handling envelopes and packages through various stages of processing, including touch screen (110) to handle various inputs from the customer, digitized voice (112) to prompt the customer and instruct him in the processing, elec- tronic weighing (138), electronic printing (142) of the ZIP+4 barcode, electronic printing of the ship- ping label (140), electronic printing of the receipt (128), electronic printing (140) of the manifest doc- umentation for both the letters and packages, and maintaining of the manifest documentation for both the letters and packages. Mailing charges are deducted from a prepaid magnetic card through the use of a magnetic card reader (122). Maintain- ing postage and shipping rates, ZIP+4 CD-ROM directory in order to locate the ZIP+4 informa- tion. A dual floppy disk system (124, 126) to allow the mailer to send electronic mail. A built-in facsi- mile apparatus (120) to allow the customer to send "FAX" information through the telephone line.		

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5

10 **AUTOMATED SELF-SERVICE PACKAGE SHIPPING MACHINE**

15 The invention relates to automated self-service systems for receiving and initially processing letters and other packages for subsequent transportation by the U.S. Postal Service and/or private package shipment companies.

20

 The Appendix sets forth copyrighted subject matter. No objection is made to reproduction of the Appendix solely in connection with reproducing any patent that may issue from this application, but all other rights under
25 copyright law are reserved.

 An automated self-service machine in accordance with the invention advantageously combines features of mailroom automation systems with features of bank
30 automated teller machines. The machine may be located in post offices, convenience stores, and the like.

 A notable aspect of the self-service machine is its user interaction. In operation, the machine conducts a
35 dialog with a user/customer, via a touch screen and a digitized voice output (or other input/output devices), to obtain information about the customer's intended shipment address, class of service, and the like. The customer may specify, e.g., first-class mail, registered

or certified mail, and the like. The customer may specify a language (e.g., English, Spanish) in which he or she wishes to communicate. Certain dialog segments are color-enhanced, e.g., a green representation of a
5 certified mail "green card" receipt is displayed on a color monitor to aid the customer in providing information about a certified mail letter.

The machine measures the weight and other dimensions
10 of the customer's package; the measurement is performed automatically for packages whose dimensions fall within specified limits. Using these measurements and the customer-provided information, the machine computes the postage or other shipping charge. The shipping charge
15 may include a fee charged by the owner of the convenience store or other machine location, e.g., to cover the overhead cost of having the machine on-site.

The machine obtains payment from the customer,
20 notably through the use of a prepaid, low-cost charge card which may be sold in convenient denominations at the machine's location (e.g., at a convenience store). A magnetic card reader for handling such cards may be connected through a conventional interface directly to,
25 e.g., a convenience store cash register. Alternatively, the customer may use a credit card to make payment.

The machine prints a routing/shipping label for the customer's package. If the package is a simple
30 first-class letter, the label may comprise a postal bar code printed directly on the letter's envelope. The bar code may embody the nine-digit ZIP+4 code of the destination address, which may be looked up by the machine from a database in a CD-ROM disk. If the package
35 is a letter to be sent by certified mail, the machine prompts the user to insert a U.S. Postal Service

[REDACTED]

certified mail "green card" blank form for printing. If the package is a box or large envelope, the machine may print a shipping or mailing label, including an appropriate routing/tracking bar code, on peel-off label stock; the customer may then apply the label to the package.

Prior to printing a shipping label or bar code, the machine may advantageously consult a directory (e.g., a ZIP+4 directory) to verify that the destination address specified by the customer is not obviously incorrect. Furthermore, the information obtained from the customer by the machine includes the customer's name, address, and telephone number, enabling the shipping company to contact the customer more readily if the customer's package cannot be delivered.

When the customer's transaction is complete, the labeled package is automatically received into a locked storage compartment in the machine. The storage compartment may be emptied at a convenient time, e.g., by a convenience store clerk, and its contents delivered to the U.S. Postal Service or other shipping company. A sensor detects when the storage compartment is full and alerts appropriate personnel.

A printer in the machine prints a customer receipt. The printer may be a thermal printer, and the receipt may be printed on aluminized stock, to reduce the chance of customer alteration of the receipt.

When a machine operator (e.g., a convenience store clerk) inputs an appropriate instruction at the "end of the day," a hard-copy manifest of packages received by the machine is generated.

5 The machine may be operated by a customer in an "Inquiry" mode. For example, a customer may use the machine simply to look up the nine-digit ZIP code for a particular street address. This feature may be provided free of charge as a courtesy.

10 Like reference numerals are used to refer to the same components and parts in all of the following Figures:

10 Figure 1 is a perspective view of an automated mailing apparatus in accordance with the present invention;

15 Figure 2 is a top view of the letter-handling system assembly of the apparatus of Figure 1;

Figure 3 is a top view of the apparatus of Figure 1;

20 Figure 4 is a front view of the apparatus of Figure 1 showing portions of a package tilting mechanism;

25 Figure 5 is a side view of the apparatus of Figure 1 showing portions of the package tilting mechanism with the package scale in the upright position;

30 Figure 6 is a side view of the apparatus of Figure 1 showing portions of the package tilting mechanism with the package scale in a tilted position;

30 Figure 7 is a side view of the apparatus of Figure 1 showing portions of a printer tilting mechanism;

35 Figure 8 is a side view of the apparatus of Figure 1 showing portions of the printer tilting mechanism when the printer is rotated to a fully upright position;

Figure 9 is a top view of the apparatus of Figure 1 showing portions of the printer tilting mechanism;

Figure 10 is a top view of the apparatus of Figure 1 showing portions of the printer tilting mechanism of Figure 9;

Figure 11 is a front view of a portion of the apparatus of Figure 1 showing the package acceptance door sliding mechanism;

Figures 12a, 12b, and 12c collectively comprise a block diagram of computer hardware in the apparatus of Figure 1;

Figure 13 is a diagram of the main electronics board of the apparatus of Figure 1;

Figures 14a, 14b, and 14c collectively comprise a schematic diagram of the control signal circuitry of Figures 12a, 12b, and 12c;

Figure 15 is a schematic diagram of the multiple-printer card 1258 from Figure 12c;

Figure 16 is an illustration of a silk-screen mask for PC board 1302 of Figure 13;

Figure 17 is a schematic diagram of the voltage-to-frequency weigh card 1202 from Figure 12a;

Figures 18a and 18b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a first class regular letter;

Figures 19a and 19b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a first class letter in "Sav-A-Day" mode;

5 Figures 20a and 20b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a first class, certified letter;

10 Figures 21a and 21b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a first class, registered letter;

15 Figures 22a and 22b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a first class, insured letter;

20 Figures 23a and 23b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in responding to a customer inquiry regarding first class mailing;

25 Figures 24a and 24b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a package;

30 Figures 25a and 25b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in responding to a customer inquiry regarding mailing of packages;

Figure 26 is a flow diagram illustrating operation of the apparatus of Figure 1 in printing packages and letters manifest;

35 Figure 27 is a data flow diagram for the control system of the apparatus of Figure 1;

Figure 28 is a data flow diagram for the first class mail subsystem of the apparatus of Figure 1;

Figure 29 is a data flow diagram for the report generation subsystem of the apparatus of Figure 1;

Figure 30 is a data flow diagram for the package handling subsystem of the apparatus of Figure 1;

Figure 31 is a data flow diagram for the machine control subsystem of the apparatus of Figure 1.

Referring to Figure 1, a self-service package shipping machine 100 according to the invention is shown. A letter-handling subsystem is shown on the right side of the machine, and a package-handling subsystem is shown on the left side. In the Figures, reference numerals are used to indicate components and parts as indicated below:

- | | | |
|----|-----|--|
| 20 | 100 | Zipster Plus ZP-3D Automated Mailing Apparatus |
| | 102 | sheet-metal housing |
| | 104 | letter acceptance slot |
| | 106 | package acceptance window |
| | 108 | package acceptance window door |
| 25 | 110 | touch-screen computer monitor, Carroll Touch Company, Austin, Texas |
| | 112 | loudspeaker |
| | 114 | work tray |
| | 116 | ruler disposed on front of work tray 114 |
| 30 | 118 | divided compartments disposed in work tray 114 for containing work supplies and preprinted USPS forms, Federal Express/UPS forms, and the like |
| | 120 | fax machine |
| 35 | 122 | magnetic card reader, COPYVENDOR cardreader by McKey Inc., of Harleysville PA - |

- 124 3-1/2 inch floppy disk drive
- 126 5-1/4 inch floppy disk drive
- 128 thermal receipt printer
- 5 130 dotted line denoting general area in which
electronics are disposed
- 132 dotted line denoting general area in which
letter-handling system assembly is
disposed
- 134 letter tray
- 10 136 dotted line denoting general area in which
mechanism for sliding window door 108 is
disposed
- 138 (dotted line denoting) tilting package scale
- 140 shipping and mail manifest printer
- 15 142 package label printer
- 144 package door
- 146 letter door
- 200 letter-handling system assembly disposed in
20 area denoted by dotted line 132 in Figure
1
- 202 PC board assembly for left-justification and
width measurement of letters
- 203 electro-optical sensors for left-justification
25 and width measurement
- 204 stepping motor, model Superior MH112 by
Superior Electric Company, Bristol CT
- 206 gate mechanism letter stops
- 208 base plate
- 30 210 linear motion guide rail (THK SR301)
- 212 letter clamp/Ledex solenoid
- 214 guide rail support blocks
- 216 idler assembly
- 218 Hewlett-Packard ink-jet printer
- 35 220 ink-jet printer pivot plate
- 221 ink-jet printer pivot plate hinge

- [REDACTED]
- 222 micro-switch for detecting when ink-jet printer
218 has rotated into fully upright
position
- 5 223 scanner (e.g., DEST Personal Scan B5N-21SCA
scanning unit scanner with B5N-21FED page
feeder)
- 224 Ledex solenoid for retracting gate mechanism
letter stops 206
- 10 226 PC board assembly for letter justification and
length measurement
- 227 electro-optical sensors for letter
justification and length measurement
- 228 letter scale
- 15 230 load cell for letter weighing, e.g.,
Transducers Incorporated, Cerritos CA,
model no. 662A-D3-10-10P1
- 400 load cell for package weighing
- 402 trap door
- 20 404 linkage for simultaneous opening of trap door
402 and tilting of package scale 138
- 406 tilting hinge
- 408 linear actuator for providing mechanical force
to tilt scale 138 and trap door 402, model
- 25 4Z846A by Dayton Corporation of Chicago
- 410 package storage compartment
- 600 package being tilted off of scale 138
- 602 packages stored in storage compartment after
30 being tilted off of scale 138
- 700 linear actuator for providing mechanical force
to rotate ink-jet printer 218, model
- 4Z846A by Dayton Corporation of Chicago
- 35 702 linkage
- 704 linkage

- 706 pivot point between linear actuator 700 and linkage 702
- 708 pivot point between linkage 702 and linkage 704
- 710 pivot point between linkage 702 and housing 102
- 5 900 dotted line indicating portion of Figure 9 which is shown in greater detail in Figure 10
- 10 1100 metal guides to prevent inward movement of door 108
- 1102 stepper motor
- 1104 Kevlar timing belt
- 1106 THK linear rail
- 15 1108 Honeywell opto-electronic limit switch
- 1110 THK bearing for movement along guide rail 1106
- 1112 idler for engaging other end of timing belt 1104
- 20 1200 PC bus
- 1201 main 80386-based computer
- 1202 voltage-to-frequency weigh card
- 1204 scanner interface card (e.g., DEST Corp.)
- 1206 Hitachi interface card
- 25 1208 Hitachi CDR-3500 CD ROM drive
- 1210 IDE hard disk/floppy disk
- 1212 IDE 40-mByte hard disk drive
- 1214 Scientific Solutions stepper motor card (Cybernetic Microsystems Inc., San Gregorio CA model no. CY-525A)
- 30 1216 Superior Motor Block 6180 -- PT Translator
- 1218 Superior Motor Block 6180 -- PT Translator
- 1220 input port
- 1222 input port
- 35 1224 input port
- 1226 safety micro-switch

- [REDACTED]
- 1228 output port
 - 1230 buzzer
 - 1232 input port
 - 1234 printer tilt relay
 - 5 1236 output port
 - 1238 paper ready indicator
 - 1240 input port
 - 1242 optical homing signals
 - 1244 input port
 - 10 1246 help switch
 - 1248 input port
 - 1250 package dump relay
 - 1252 output port
 - 1254 solenoids and clamps
 - 15 1256 facsimile interface card (e.g., Intel SatisFAXtion) f
 - 1258 multiple printer card
 - 1260 voice digitizer (e.g., Covox Inc., Eugene Oregon - Voicemaster Digitizer System 2; software version 2.04/2.04x)
 - 20 1262 modem (e.g., Hayes compatible)
 - 1264 telephone line
 - 1266 floppy disk controller
 - 25 1300 main electronics board which is disposed in the area denoted by dotted line 130 in Figure 1
 - 1302 printed circuit board
 - 1304 computer power supply
 - 30 1306 terminal strip
 - 1308 3-inch wireway
 - 1310 12-V, 15-V power supply
 - 1312 30-V, 60-V power supply
 - 35 ZP1000 signal distribution board - Easthem Associates, Houston

Some features of the machine 100 are particularly noteworthy. As shown in Figure 2, the ink jet printer is tilted downward when at rest (the normal position of the HP printer), and rotated up as needed to print upward.

5 This is done by using an electrical linear actuator 700 and rotation linkages as shown in the Figure.

Packages are weighed by using a 100 lb load cell (strain gauge bridge). When a package is accepted, the

10 package platform 138 is tilted by an electrical linear actuator 408 to tip the package into the storage compartment area ____.

The package window mechanism is secured in the up

15 position by a Ledex size 6ep solenoid. Once the solenoid is activated, the lock is released and the Superior stepping motor MH-LLR-PF-8020 begins to rotate. The motion is transferred into linear motion up and down by using a Kevlar timing belt. The THK bearing and the

20 idler pulley to home the window into its position. We are using optical sensor limit switches by Honeywell. The package window mechanism is mounted on the inner side of the package door.

25 The machine 100 of the illustrative embodiment is operated by computer software shown in detail in the Appendix, which comprises 265 pages each numbered in the lower right corner with serial numbers PI00001 through PI00265. As shown in the Appendix, a series of screen

30 displays is presented to a user/customer on the touch screen 110; the customer's responses on the touch screen 110 or other input device (e.g., a conventional computer keyboard) are used in controlling the machine's operations.

[REDACTED]

The software controlling the machine also includes a ZIP+4 database and lookup software. In the illustrative embodiment, the ZIP+4 database and control software distributed by the First Data Resource Company of
5 Memphis, Tennessee is used.

The interrelationship of the various parts of the machine 100 may be conveniently described through a discussion of the operation of the machine.

10

A user/customer starts the machine by inserting a prepaid charge card into the receiving slot of a magnetic card reader 122, which activates the apparatus. The charge card may be a conventional stiff-paper card with a
15 magnetic stripe on one side, similar to those used by the Bay Area Rapid Transit system (BART) in the San Francisco area.

The customer then touches the touch screen 110,
20 which may be a conventional touch screen activated by an infrared array or sonic waves or resistance screen. Touching the screen activates a voice system which instructs the operator through a loudspeaker 112 what the next step will be. By following the voice instruction
25 and the printed instructions on the screen 110, the customer is led step by step through the processing of a package or a letter.

As shown by the illustrative screen displays in the
30 Appendix and by the flow diagrams in Figures __, once the customer has selected a First Class letter he follows the instructions. The customer then puts the letter into the letter acceptance slot 104. The letter handling system
200 moves the letter automatically through weighing,
35 measuring, scanning and printing and finally depositing

the letter into the removable letter tray where all processed letters are collected.

5 Once a letter is processed, a receipt is printed for any letter that is certified, registered and insured. The cost of mailing is deducted from the prepaid magnetic card and the card is returned to the customer.

10 The customer is able to request an electronic mail operation (e.g., using a conventional electronic mail service such as MCI Mail) using one of the two types of floppy-disk drives 124, 126 by inserting a floppy disk into the drive and following the voice/touch screen 110 instruction. The customer is thereby able to transmit
15 his files to another computer. The cost of the electronic mailing is deducted from the prepaid magnetic card and the card is returned to the customer.

20 The customer is able to request to use the built-in FAX scanner 120 in order to transmit documents across telephone lines to another location. The customer follows the voice and screen instruction and then inserts his documents one by one into the FAX scanner 120. The machine 100 automatically transmits the documents to the
25 other location. The cost of mailing is deducted from the prepaid magnetic card and the card is returned to the customer.

30 The customer may select after inserting his prepaid magnetic card to process packages by touching the screen 110 and following the voice instructions. The package window door 106 opens, the customer puts the package inside the window on the package/scale/tilt assembly 400. The scale weighs the package; this weight is transmitted
35 to the computer which calculates the charges according to the destination zipcode. Once all the information that

[REDACTED]

relates to the shipper and destination is entered by the customer using the touch screen 110, a shipping label is printed using a package label printer 142. The customer pastes the label to the package and touches the screen on the appropriate box as shown by the illustrative screen displays in the Appendix. Once the customer has finished the processing, the package window door 108 is automatically closed. A receipt is produced by the receipt printer 128. The cost of shipping the package is deducted from the prepaid magnetic card and the card is returned to the customer.

To detect customer attempts to cheat (e.g., by submitting a light package for weighing but actually depositing a heavier package for shipping), the package is reweighed just prior to acceptance. If more than a +1% variation is detected, an error message is generated and the package is not accepted.

To reduce the chance of a too-heavy weight measurement (e.g., because the customer inadvertently has his finger on the scale), the scale detects weight variations of 0.01 oz. The weight is not measured for shipping-charge computation purposes until the weight stabilizes.

The tare (zero weight) of the scale is monitored to verify that nothing is left on the scale and that the scale is not damaged.

It will be appreciated that the foregoing embodiment is described for purposes of illustration and not as a limitation on the exclusive rights of the inventors. Various changes may be made (e.g., through the substitution of components; implementation of software functions in hardware and vice versa; and the like)

without departing from the spirit of the invention. The embodiments which are claimed as the exclusive property of the inventors are as described in the claims below.

CLAIMS:

1. An automated self-service package shipping machine comprising:

5

(a) means for receiving a package;

(b) screen-display means for displaying user instructions;

10

(c) user input means for transmitting user preferences;

15

(d) means for printing a destination label;

(e) means for printing a customer receipt; and

(f) locking means for securing the package.

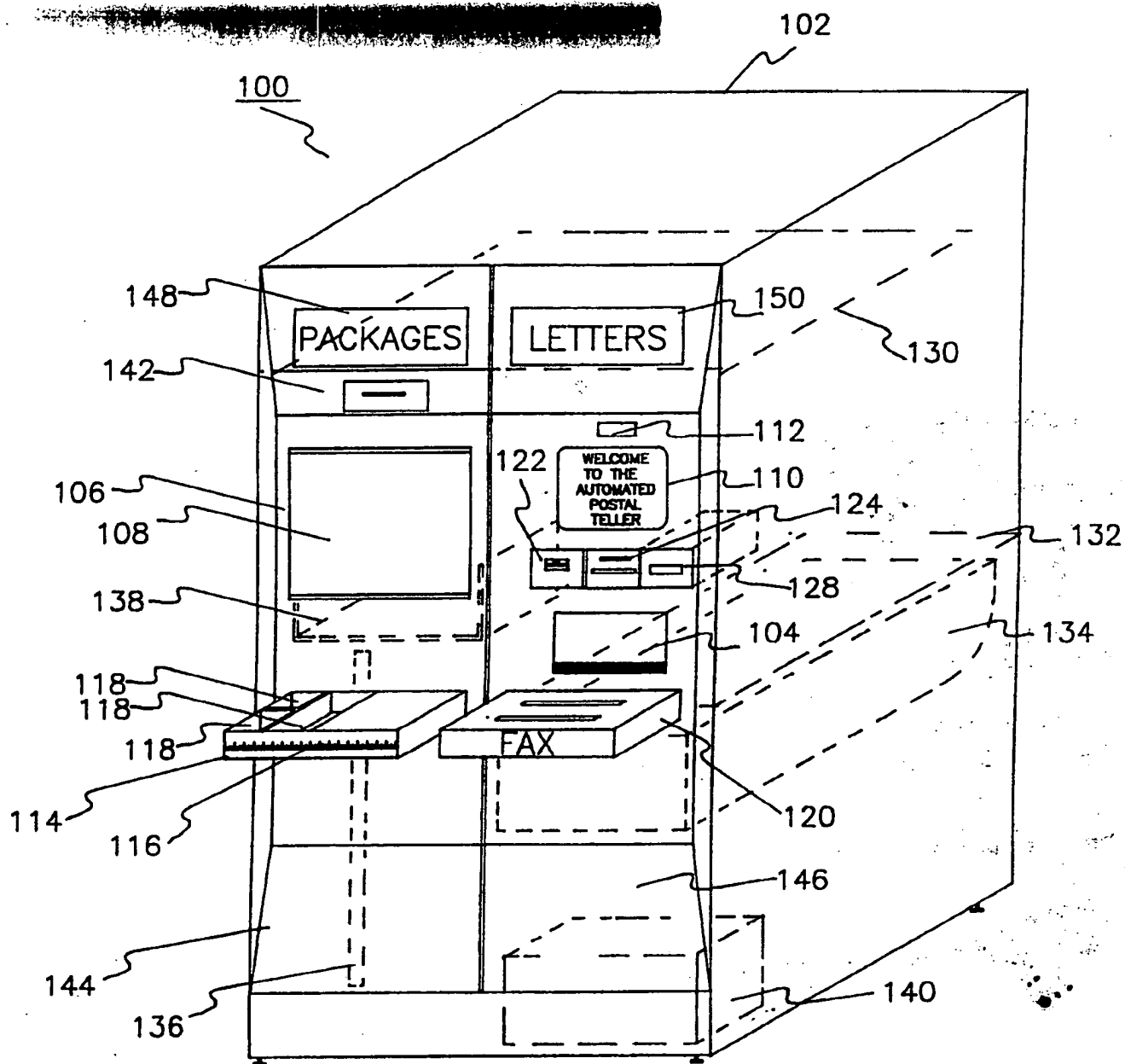


Figure 1

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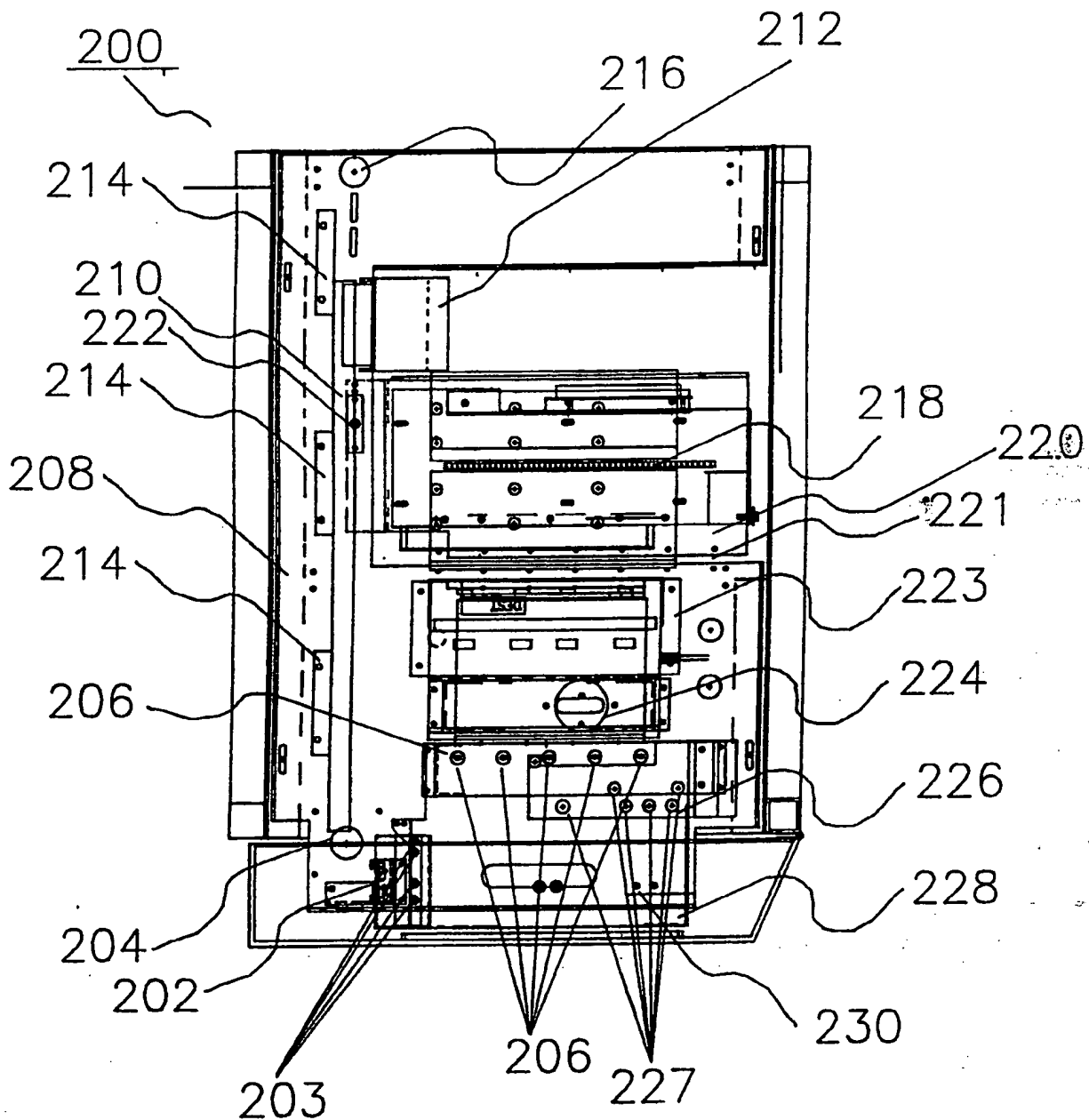


Figure 2

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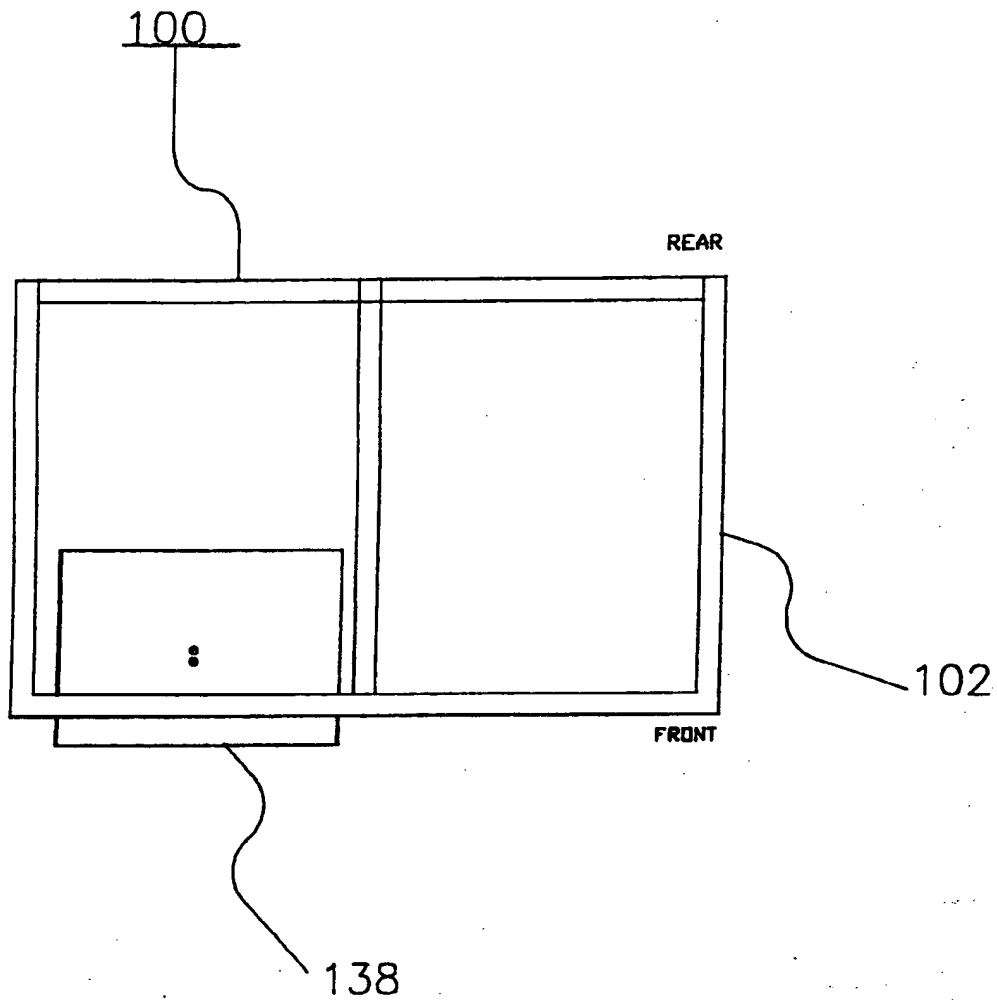


Figure 3

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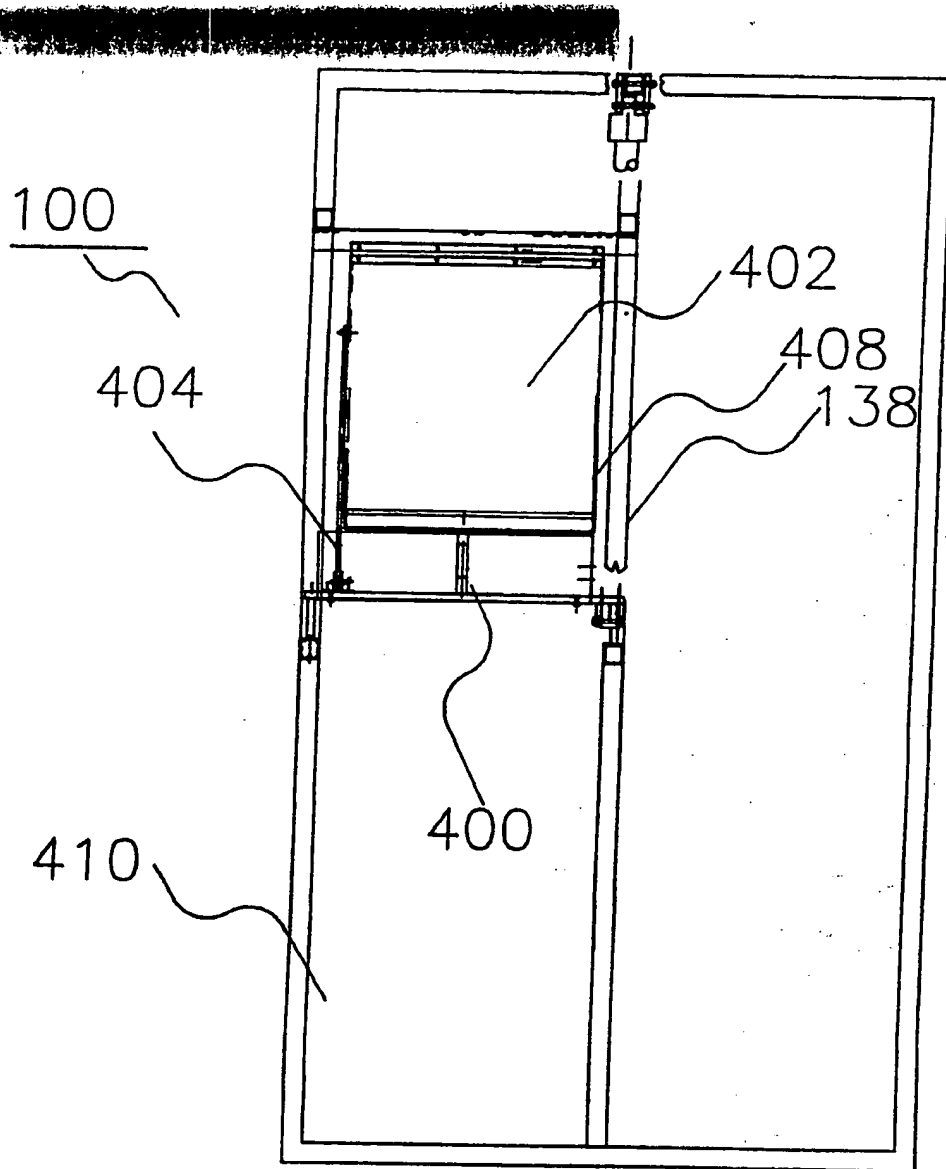


Figure 4

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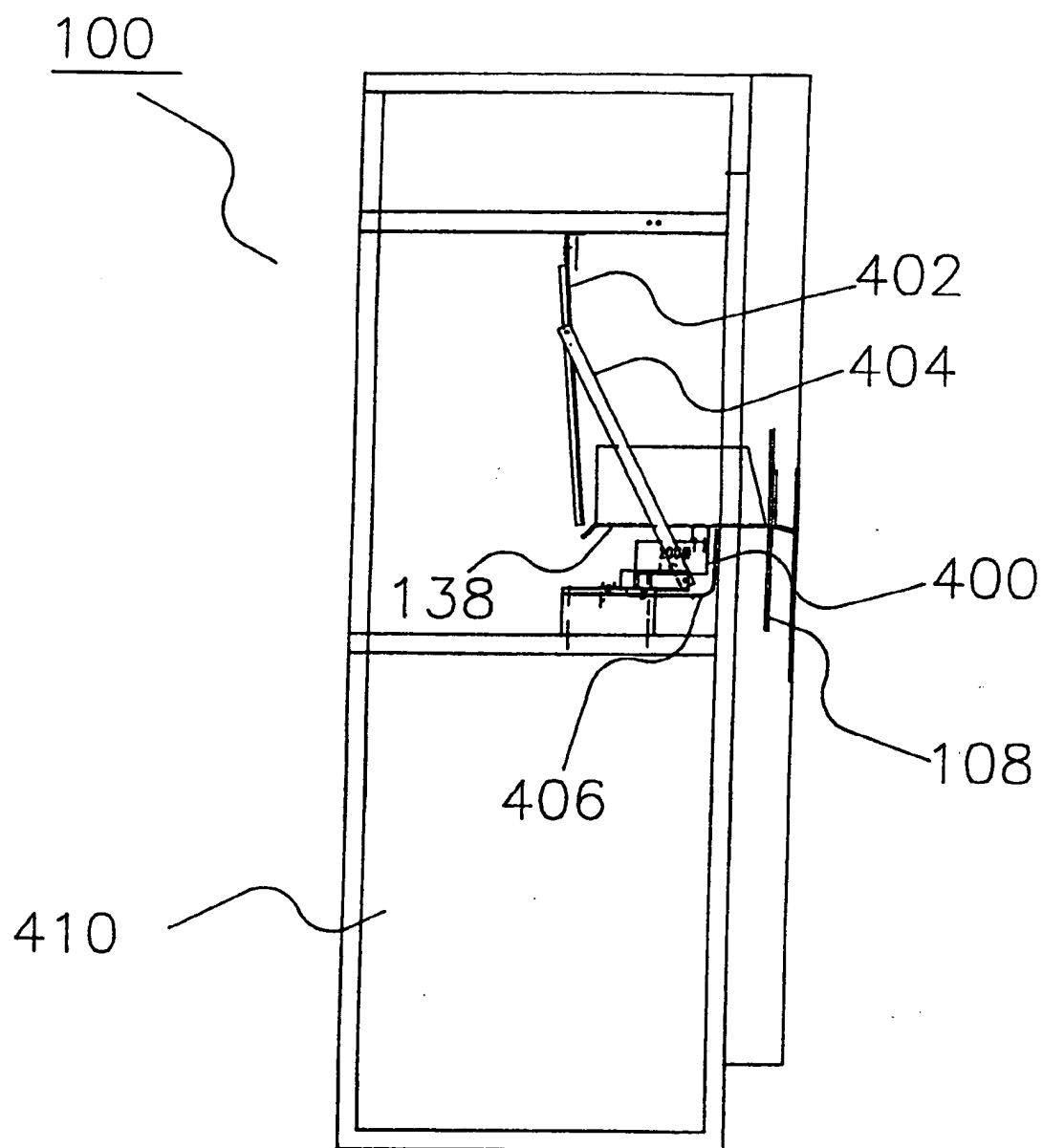


Figure 5

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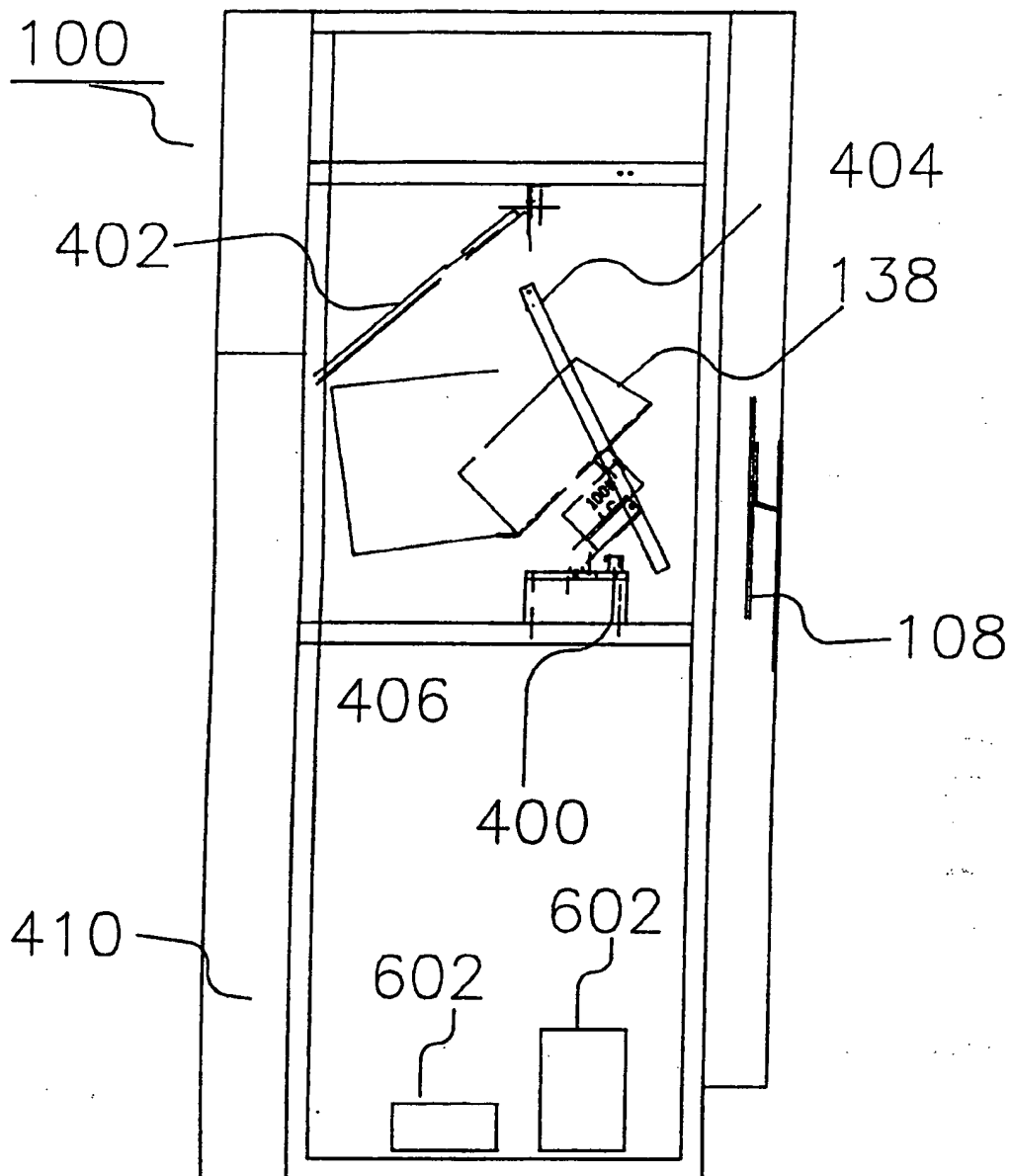


Figure 6

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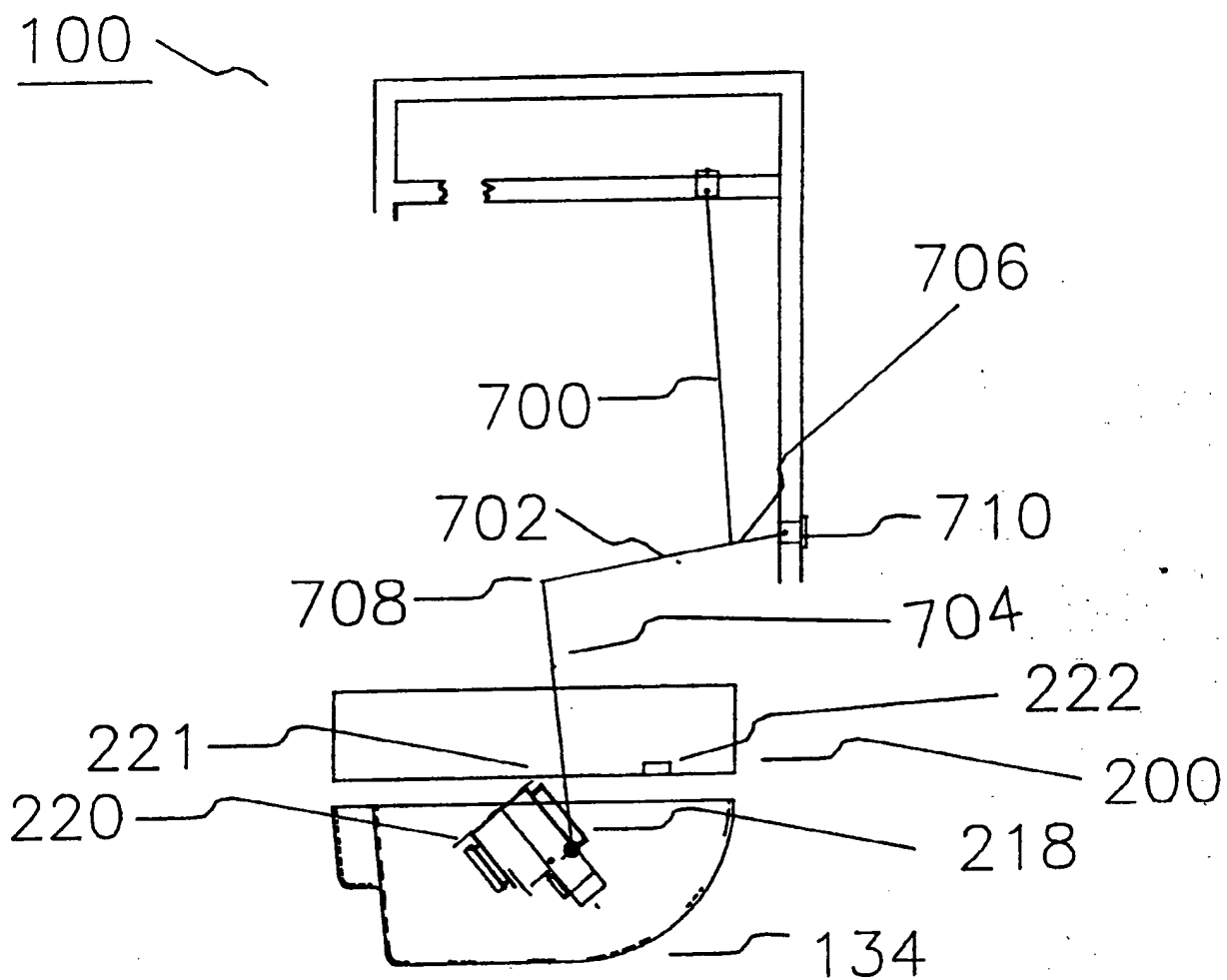


Figure 7

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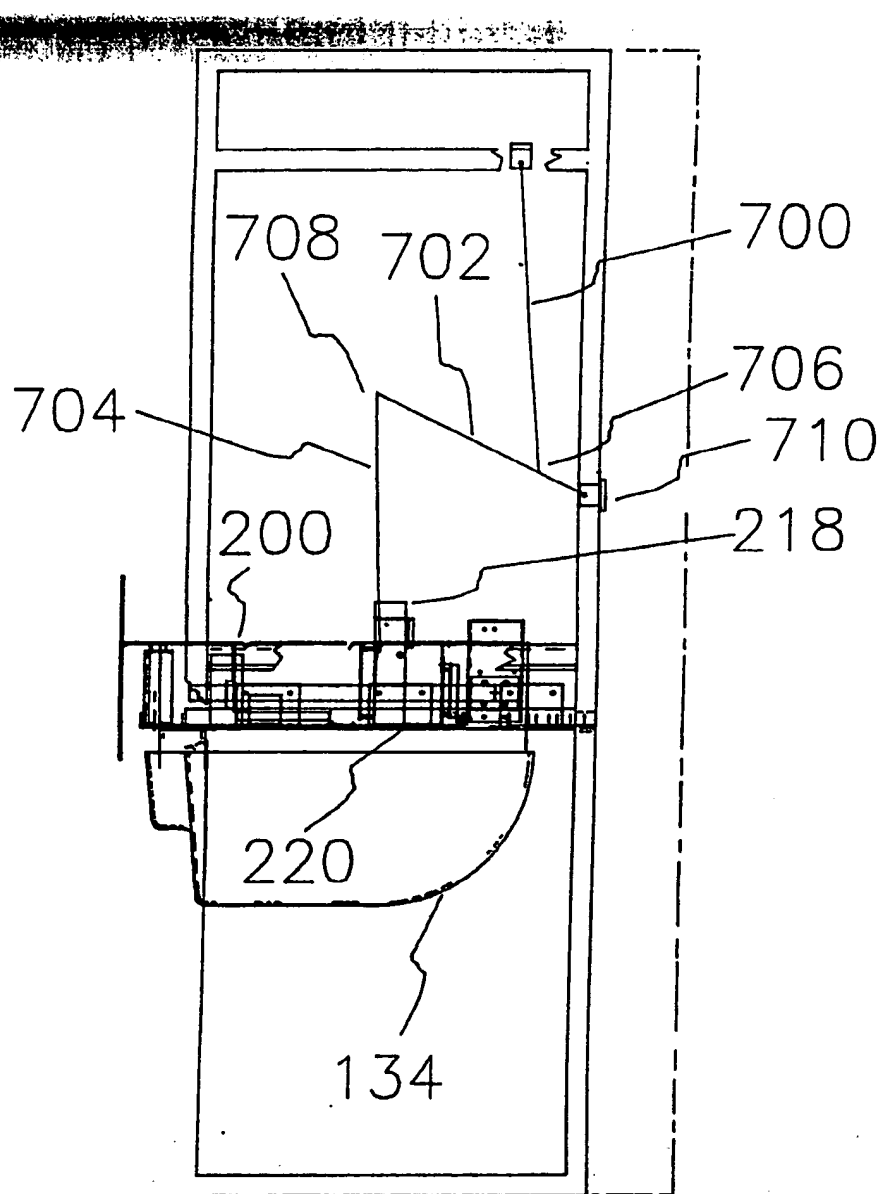


Figure 8

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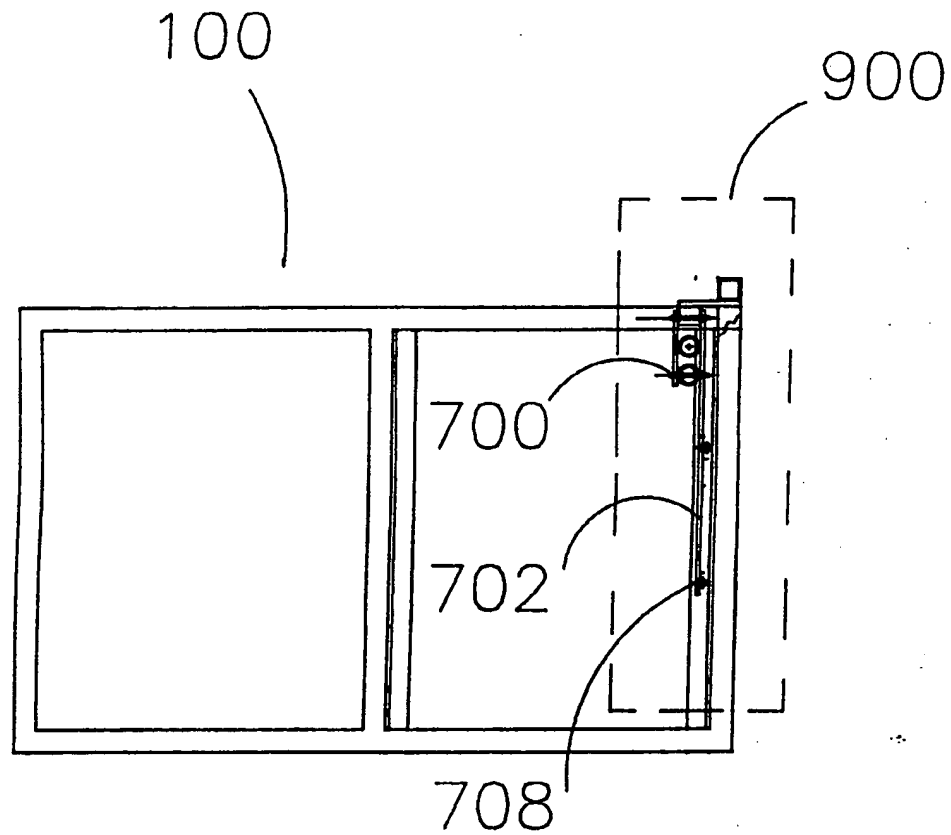


Figure 9

10/40

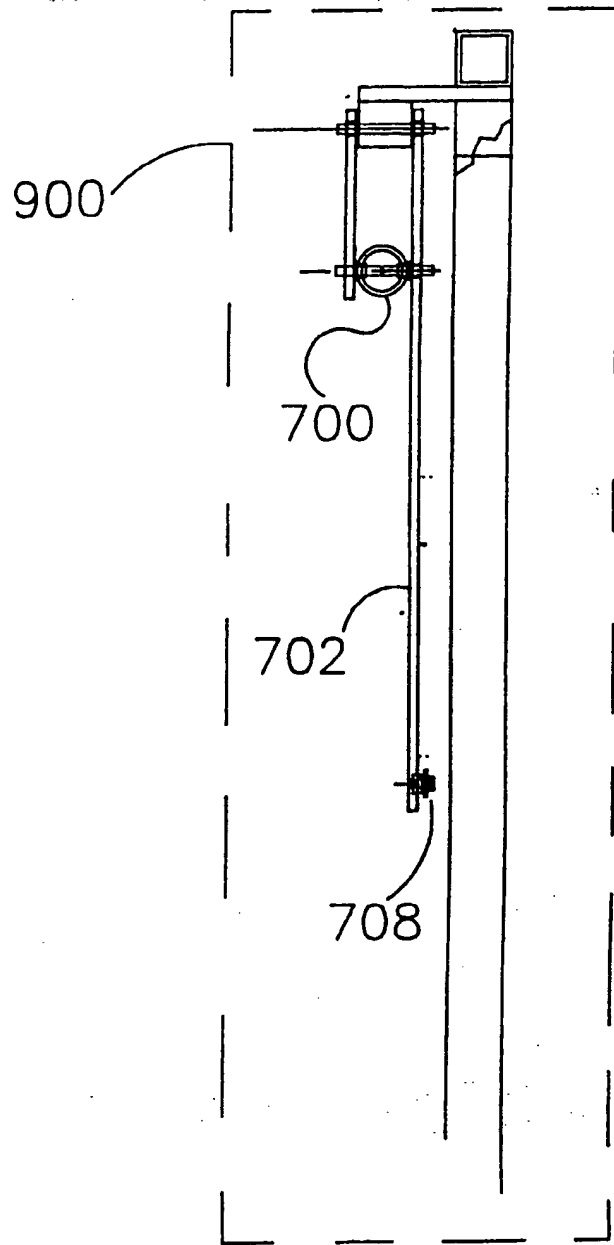


Figure 10

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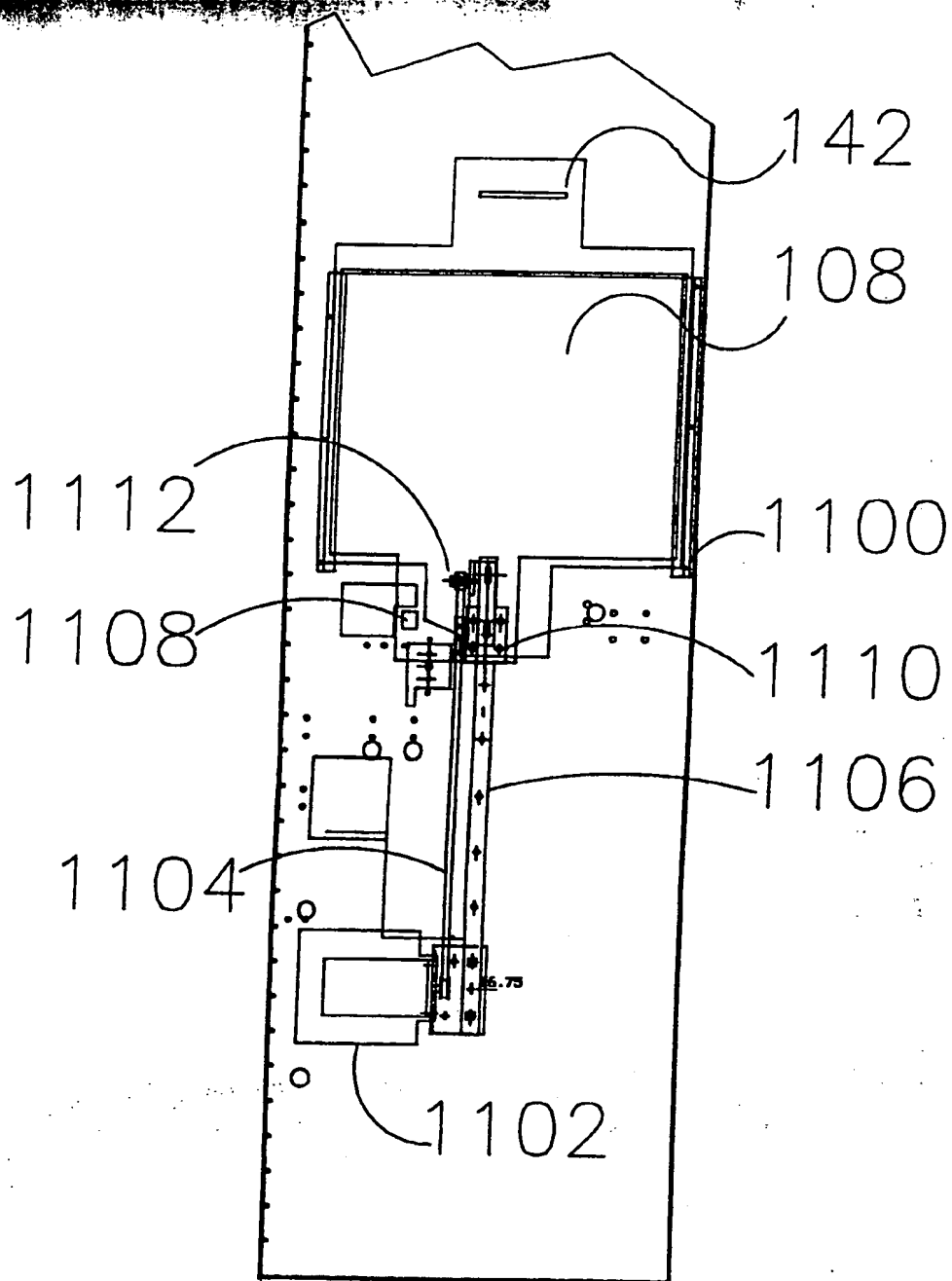
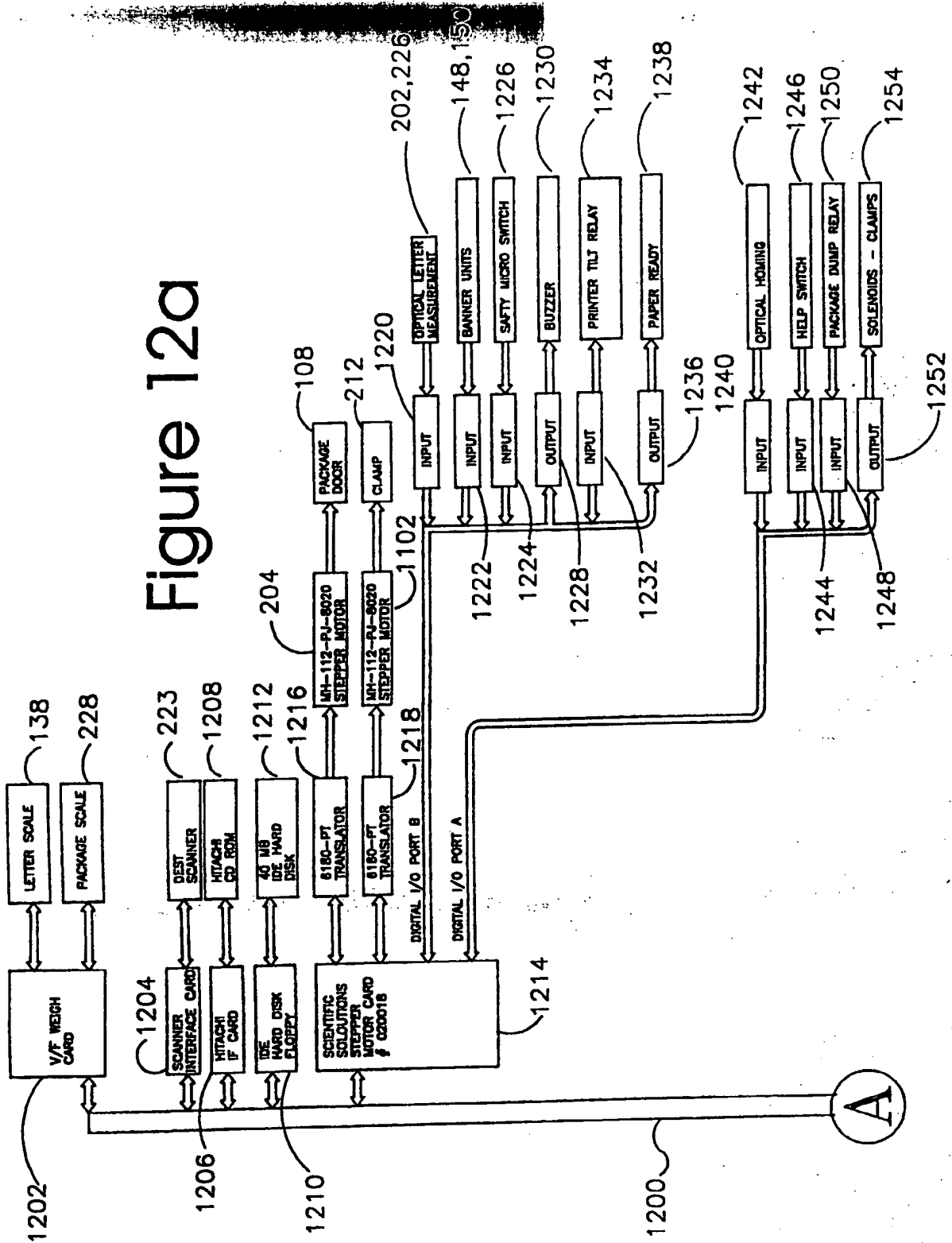


Figure 11

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Figure 12a



13/45

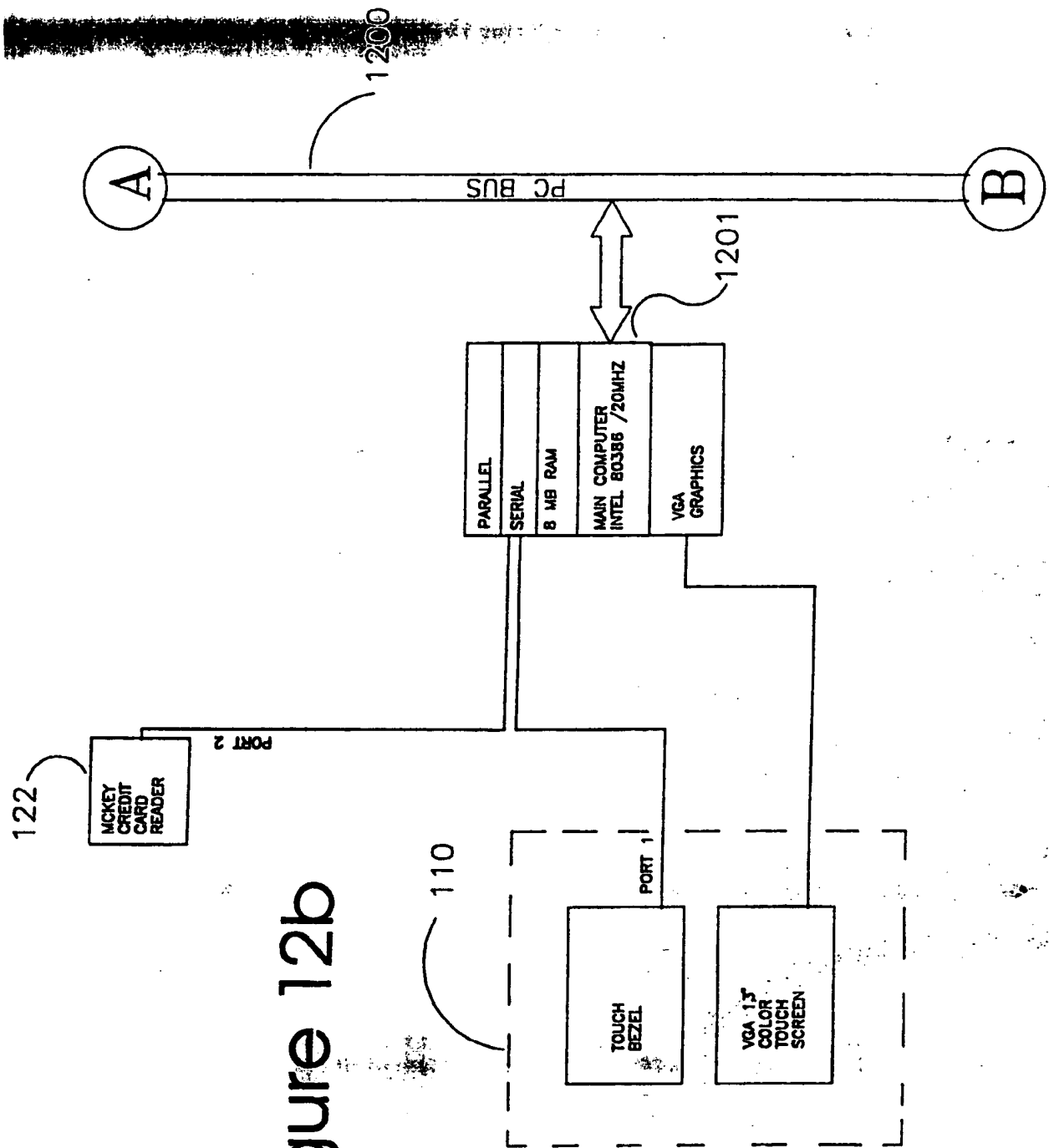
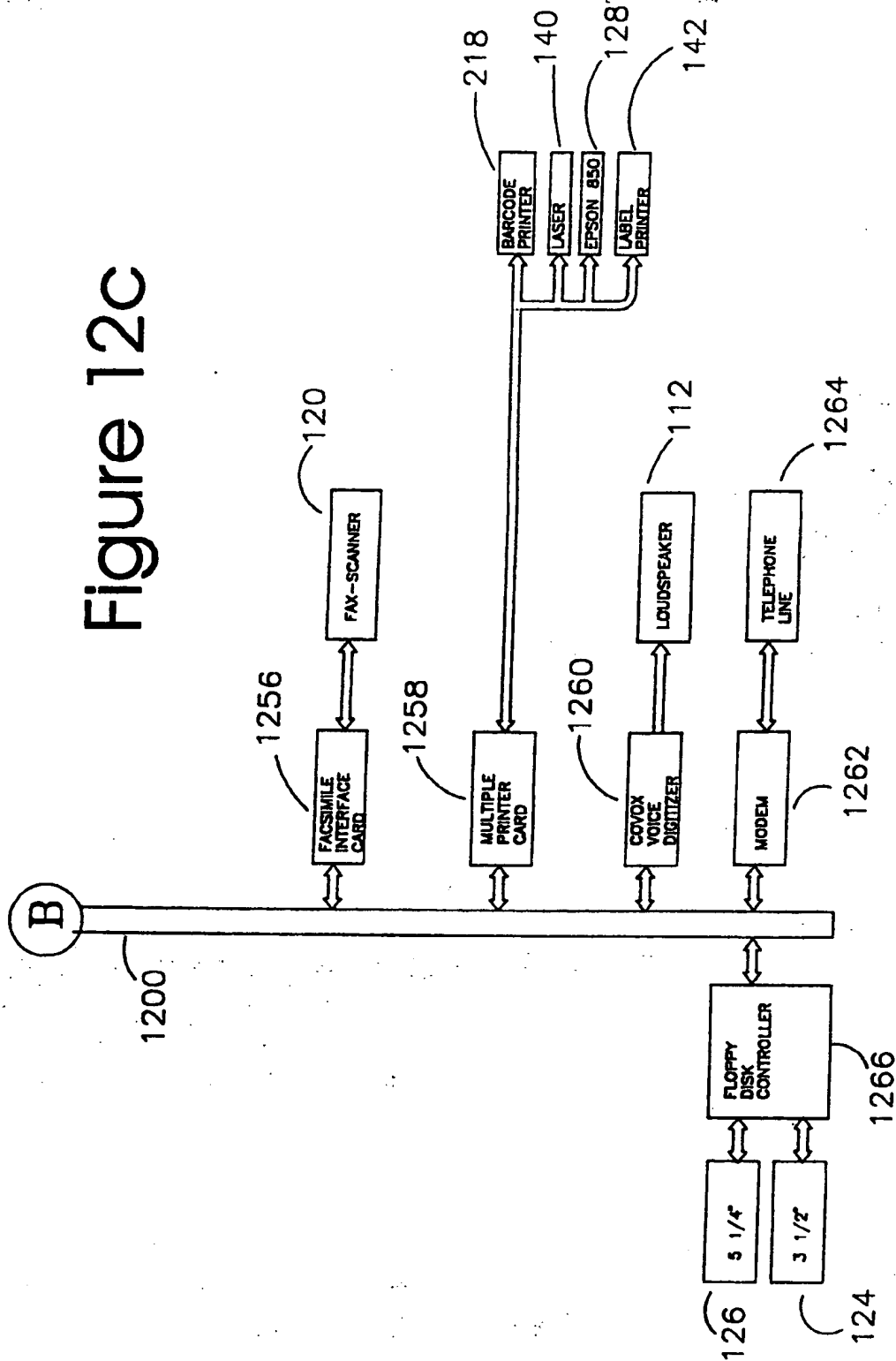


Figure 12b

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Figure 12c



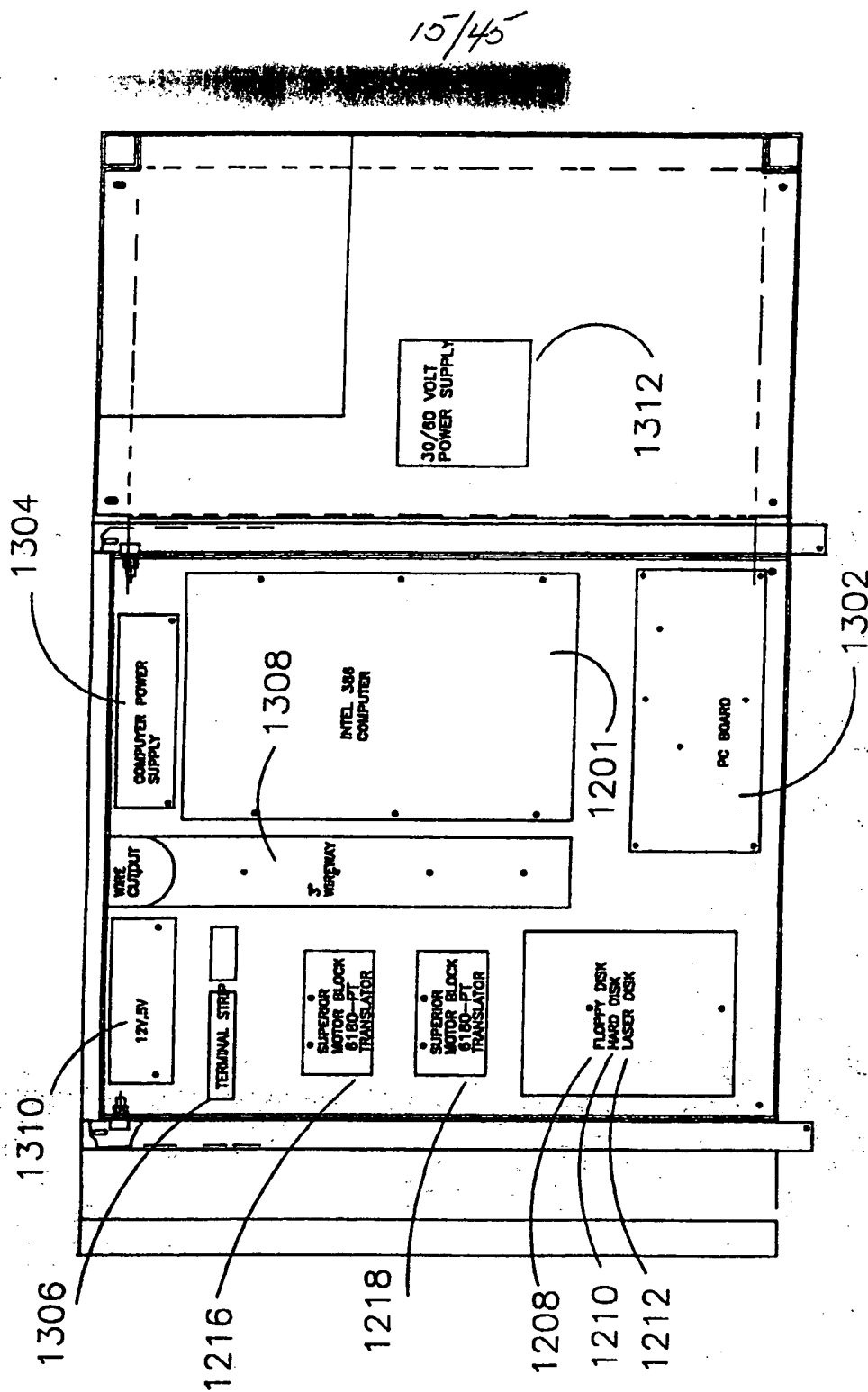


Figure 13

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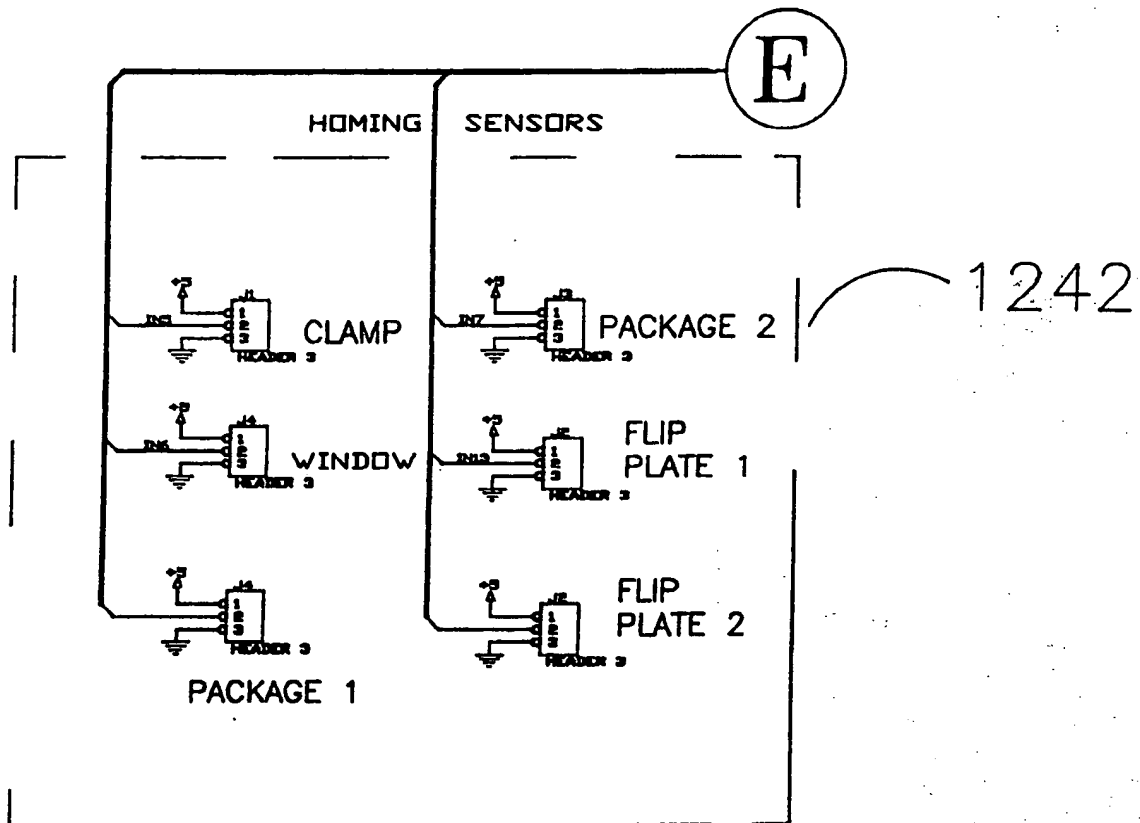


Figure 14a

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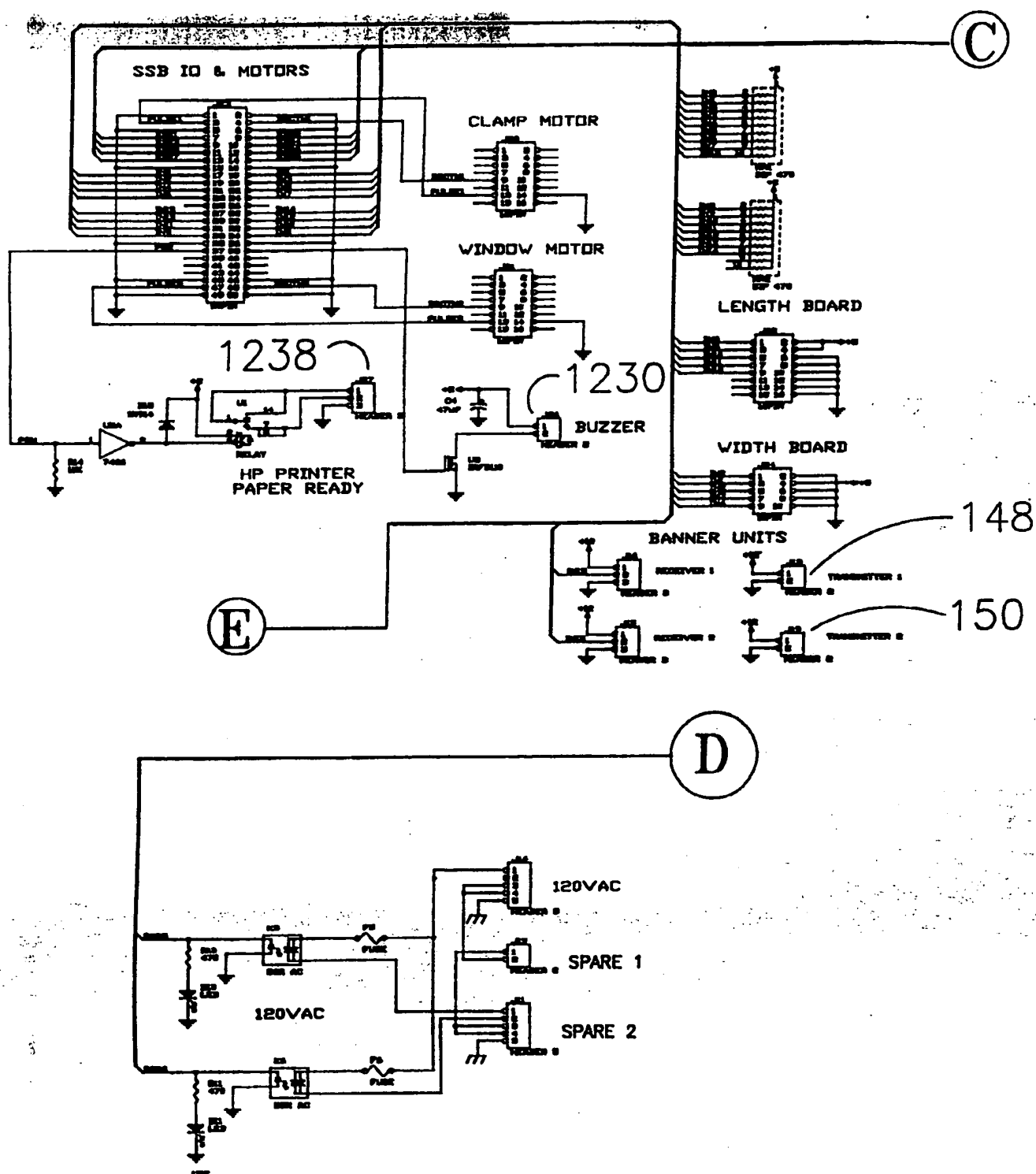


Figure 14b

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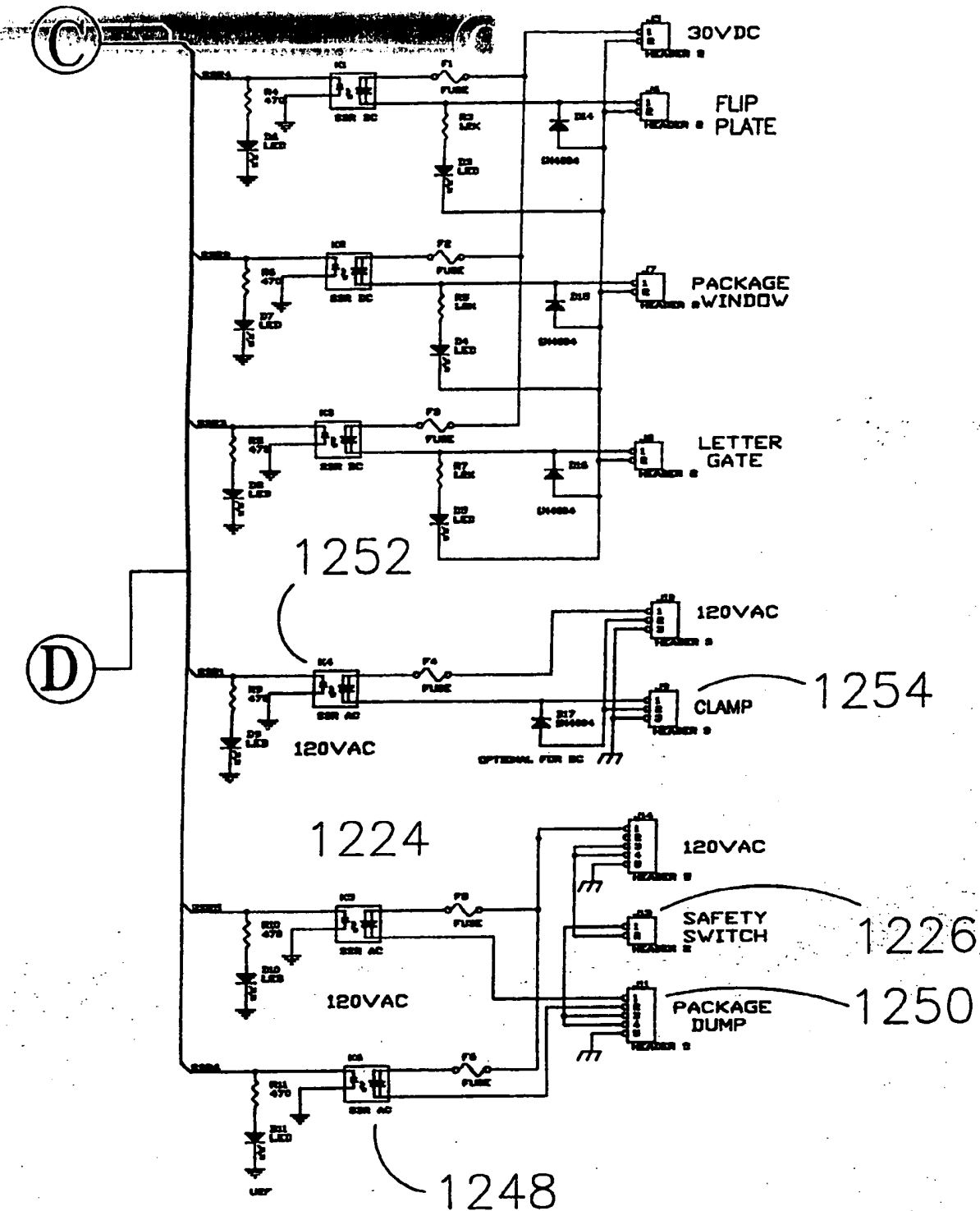


Figure 14c

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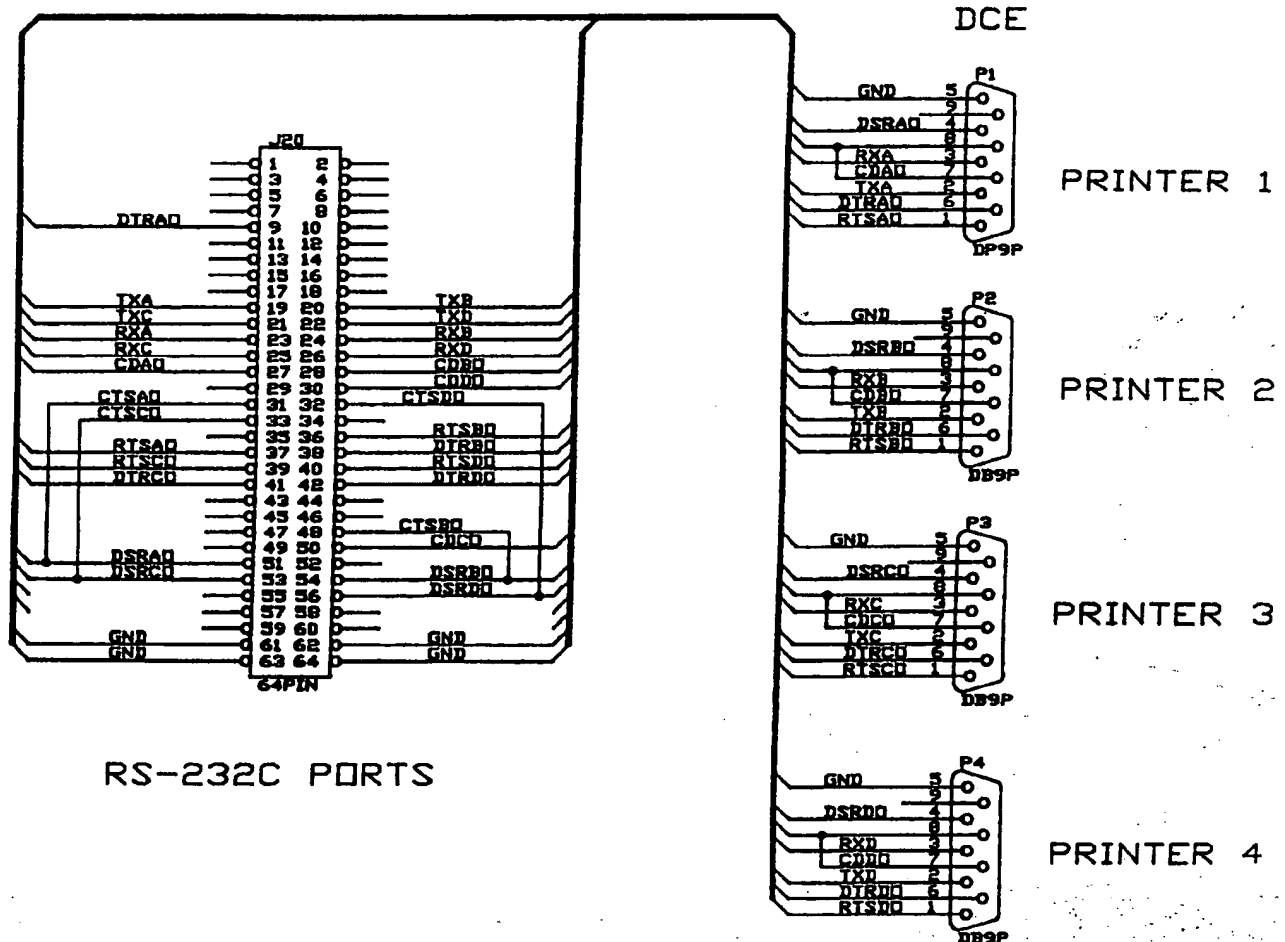


Figure 15

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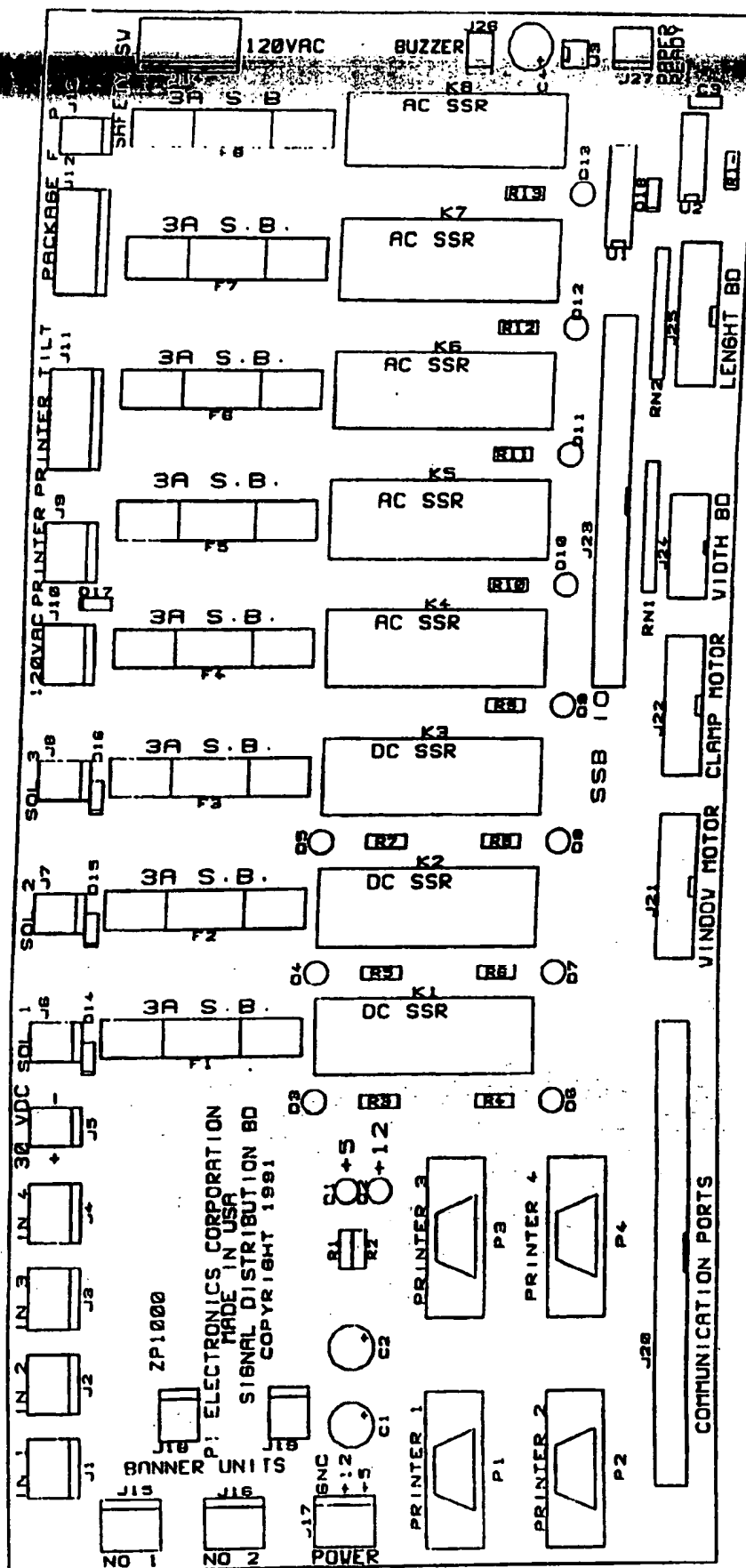
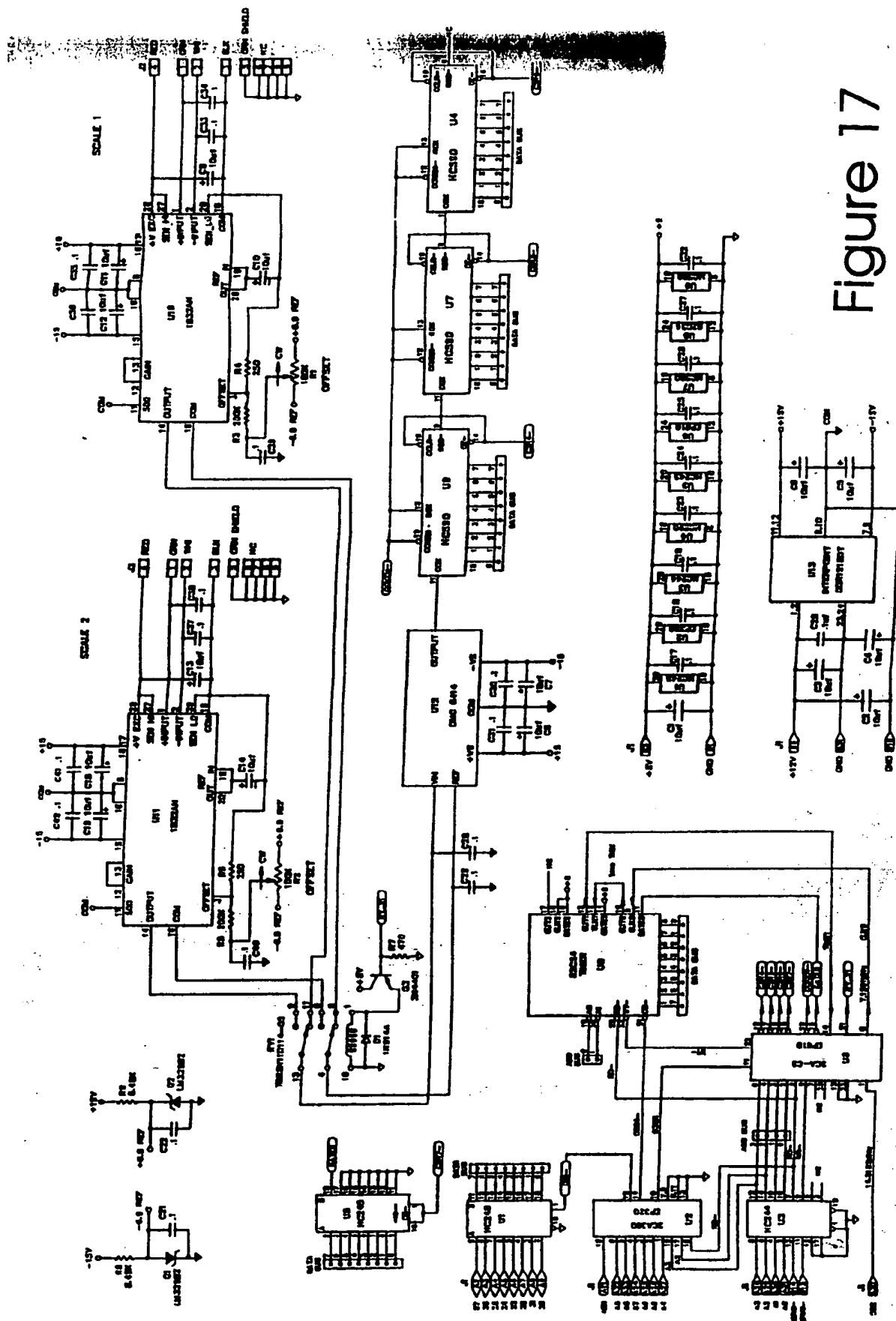


Figure 16

SUBSTITUTE SHEET

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SUBSTITUTE SHEET

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PI ELECTRONICS CORP

17-Nov-89

BOARD
SCALE DBFILE
SCALE.WK1

CKT REF	PART #	DESCRIPTION	MANUFACT	SUPPLIER	PER BD.
U01,5	MC74HC245N	OCTAL, TS, BUS, XCVR	MOTOROLA	HALL-MARK	2
U02	EP320DC-2	EPLD, 20-PIN	ALTERA, TI	MARSHALL	1
U03	MC74HC244N	OCTAL, TS, INV BUS DRV	MOTOROLA	HALL-MARK	1
U04,7,9	SN74HC590AN	8-BIT, CNTR, BUF T-S	TI	MARSHALL	3
U06	EP610DC-30	EPLD, 24-PIN	ALTERA, TI	MARSHALL	1
U08	CP82C54	TIMER, CMOS	HARRIS	SCHWEBER	1
U10,11	1B32AN	LOADCELL, AMP, EXCIT	ANALOG DEV	ANALOG DEV	2
U12	DMC8414	V/F, 1MHz	DYMEC	DYMEC	1
U13	DDR1215DT	DC-DC CONV, 12-15V	INTERPOINT	INTERPOINT	1
R01,2	3299X-1-104	POT, 100K	BOURNS	ANY	2
R02,5	200K	RES, CF, 1/4W, 5%	ANY	ANY	2
R04,6	250	RES, CF, 1/4W, 5%	ANY	ANY	2
R07	470	RES, CF, 1/4W, 5%	ANY	ANY	1
R08,9	6.49K	RES, MF, RN55D, 1%	ANY	ANY	2
C01-16	199D106X9025CA1	10UF, 25V, 20%, TANT	SPRAGUE	MARSHALL	16
C17-42	CW20C104K	.1UF, 50V, 10%	CENTRLAB	MARSHALL	26
Q03	2N4401	NPN, TRAN, SIG	MOTOROLA	SCHWEBER	1
Q01,2	LM329BZ	ZENER, REF, 6.9V	NATIONAL	SCHWEBER	2
D01	1N914A	DIODE, SIG	ANY	ANY	1
J02,3	747844-4	DB9, RT ANG, FEMALE	AMP	KENT	2
	205817-1	NUTS, 10-40, FOR ABOVE	AMP	KENT	2
RY01	TB85N11D114-05	RELAY, SPDT	P&B	HARRISON	1
BD	PCB 50011-01	BOARD,	Pi	Pi	1

Figure 17.1

SUBSTITUTE SHEET

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PI ELECTRONICS CORP

Pi ELECTRONICS CORP

17-Nov-89

BOARD
SCALE DBFILE
SCALE.WK1

CKT REF	PART #	DESCRIPTION	MANUFACT	SUPPLIER	PER BD.
U10,11	1B32AN	LOADCELL, AMP, EXCIT	ANALOG DEV	ANALOG DEV	2
R03,5	200K	RES, CF, 1/4W, 5%	ANY	ANY	2
R04,6	250- Λ	RES, CF, 1/4W, 5%	ANY	ANY	2
D01	1N914A	DIODE, SIG	ANY	ANY	1
R08,9	6.49K	RES, MF, RN55D, 1%	ANY	ANY	2
R01,2	3299X-1-104	POT, 100K	BOURNS	ANY	2
R07	470	RES, CF, 1/4W, 5%	ANY	ANY	1
U12	DMC8414	V/F, 1MHz	DYMEC	DYMEC	1
U01,5	MC74HC245N	OCTAL, TS, BUS, XCVR	MOTOROLA	HALL-MARK	2
U03	MC74HC244N	OCTAL, TS, INV BUS DRV	MOTOROLA	HALL-MARK	1
RY01	TB85N11D114-05	RELAY, SPDT	P&B	HARRISON	1
U13	DDR1215DT	DC-DC CONV, 12-15V	INTERPOINT	INTERPOINT	1
J02,3	747844-4	DB9, RT ANG, FEMALE	AMP	KENT	2
	205817-1	NUTS, 10-40, FOR ABOVE	AMP	KENT	2
U02	EP320DC-2	EPLD, 20-PIN	ALTERA, TI	MARSHALL	1
C01-16	199D106X9025CA1	10UF, 25V, 20%, TANT	SPRAGUE	MARSHALL	16
U06	EP610DC-30	EPLD, 24-PIN	ALTERA, TI	MARSHALL	1
C17-42	CW20C104K	.1UF, 50V, 10%	CENTRLAB	MARSHALL	26
U04,7,9	SN74HC590AN	8-BIT, CNTR, BUF T-S	TI	MARSHALL	3
BD	PCB 50011-01	BOARD,	Pi	Pi	1
Q03	2N4401	NPN, TRAN, SIG	MOTOROLA	SCHWEBER	1
Q01,2	LM329BZ	ZENER, REF, 6.9V	NATIONAL	SCHWEBER	2
U08	CP82C54	TIMER, CMOS	HARRIS	SCHWEBER	1

Figure 17.2

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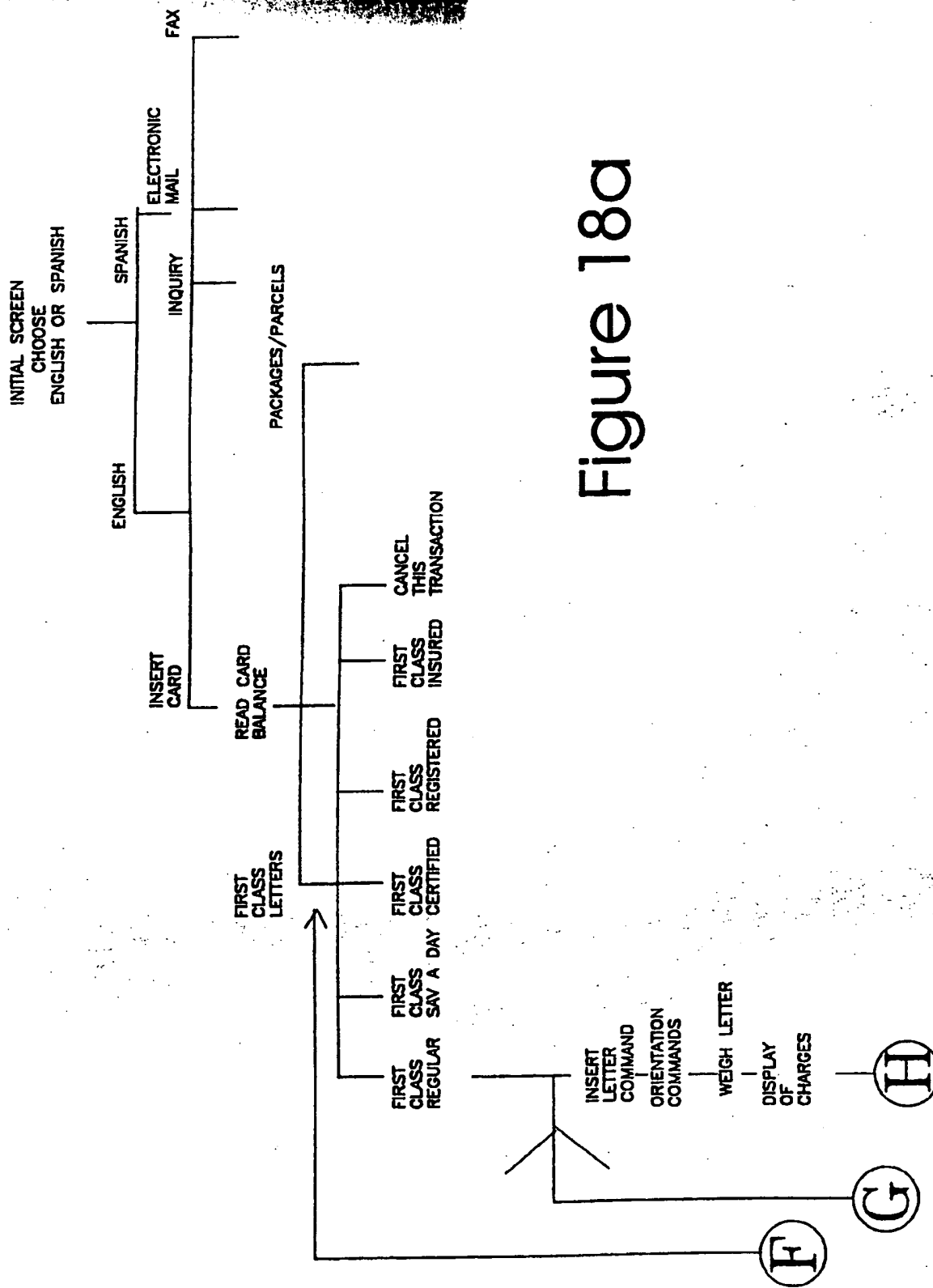


Figure 18a

25/45

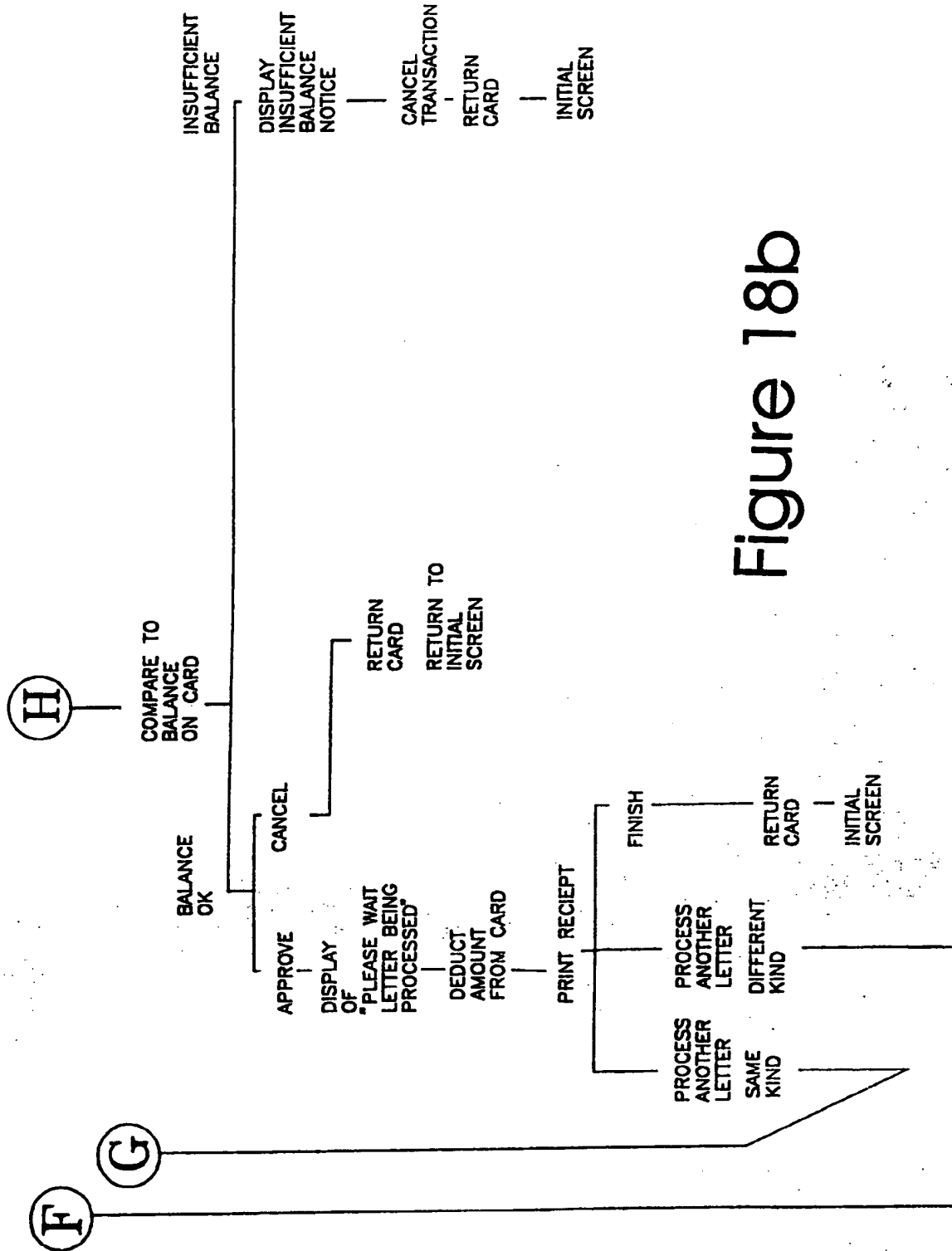


Figure 18b

26/40

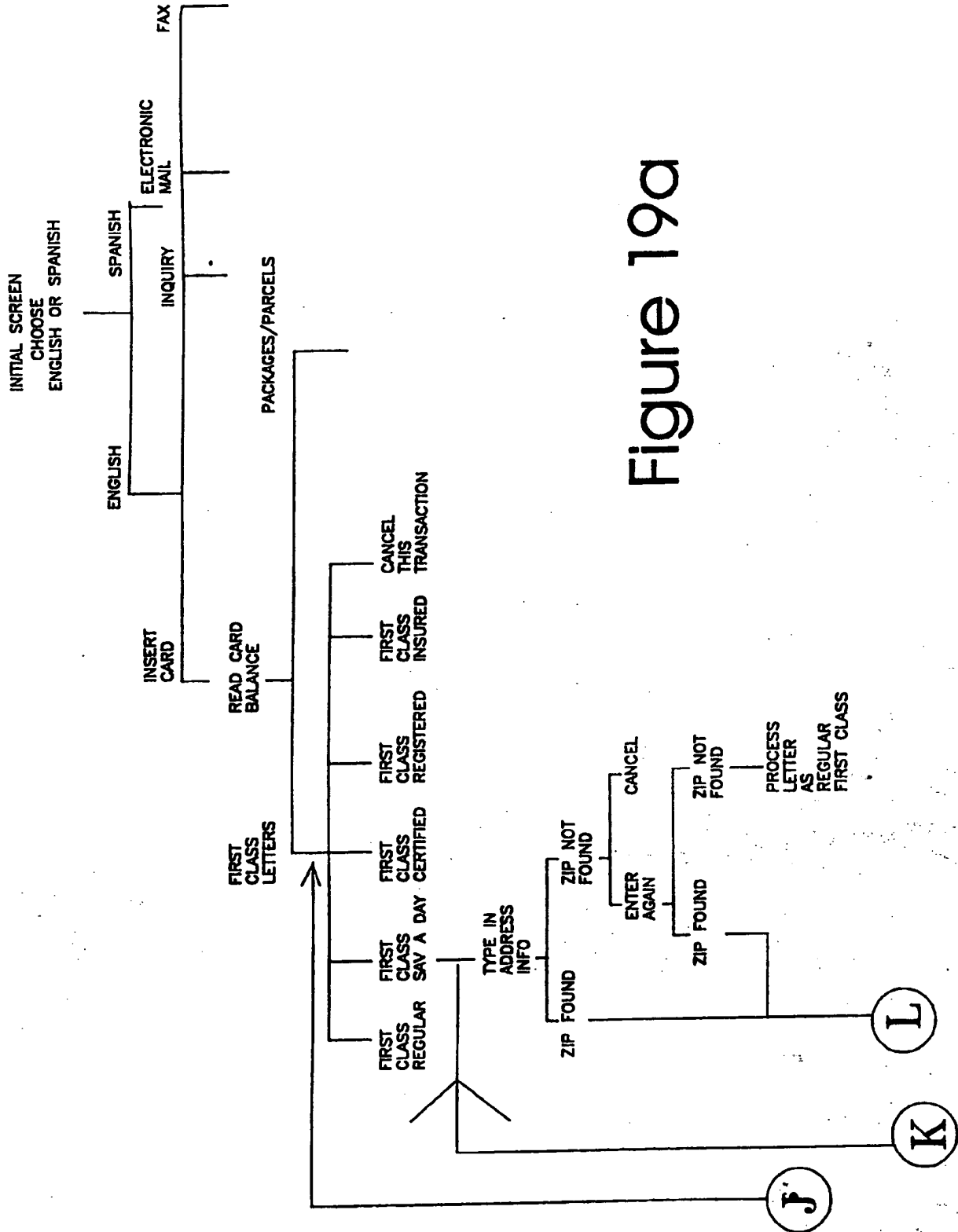


Figure 19a

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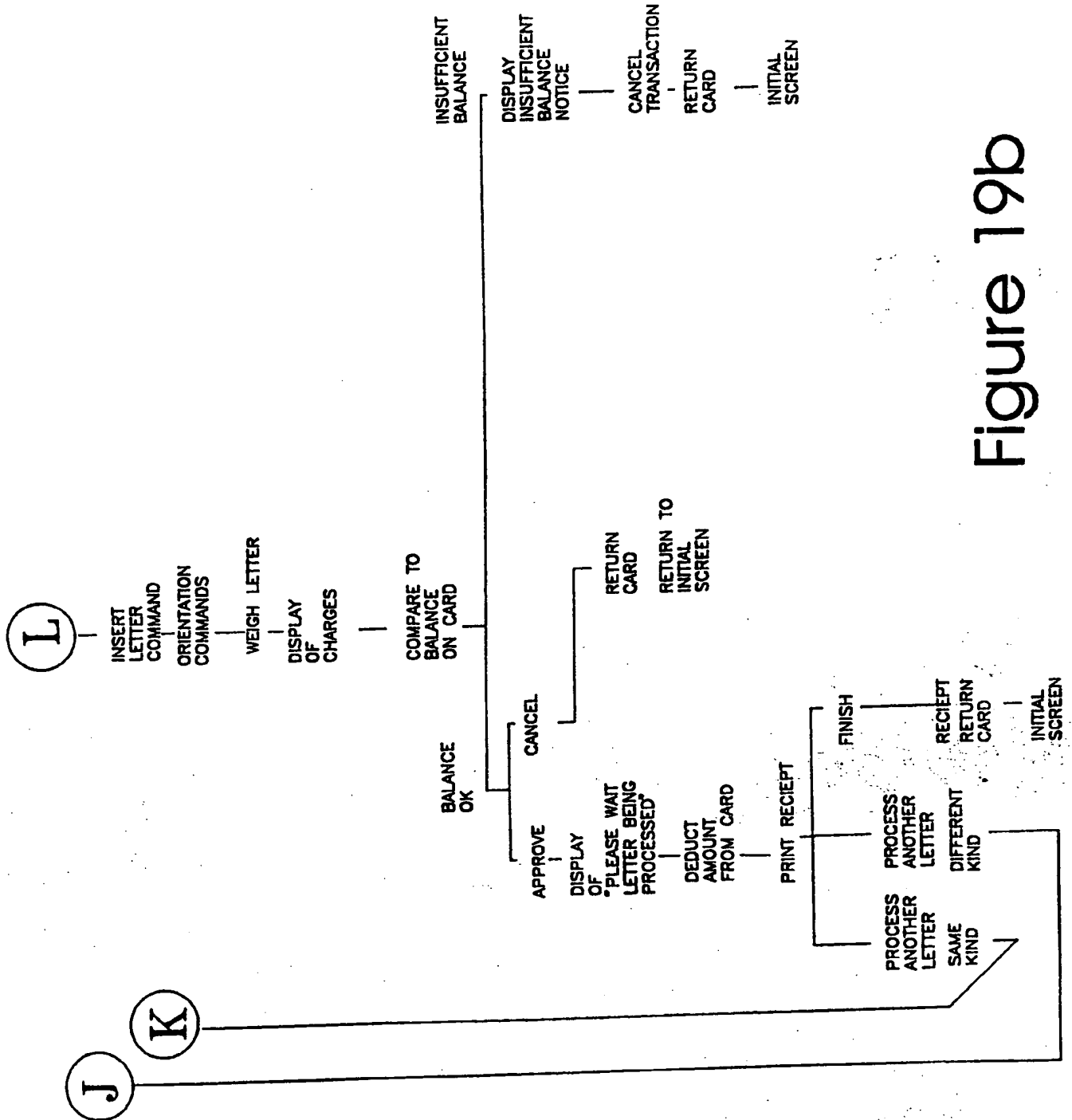


Figure 19b

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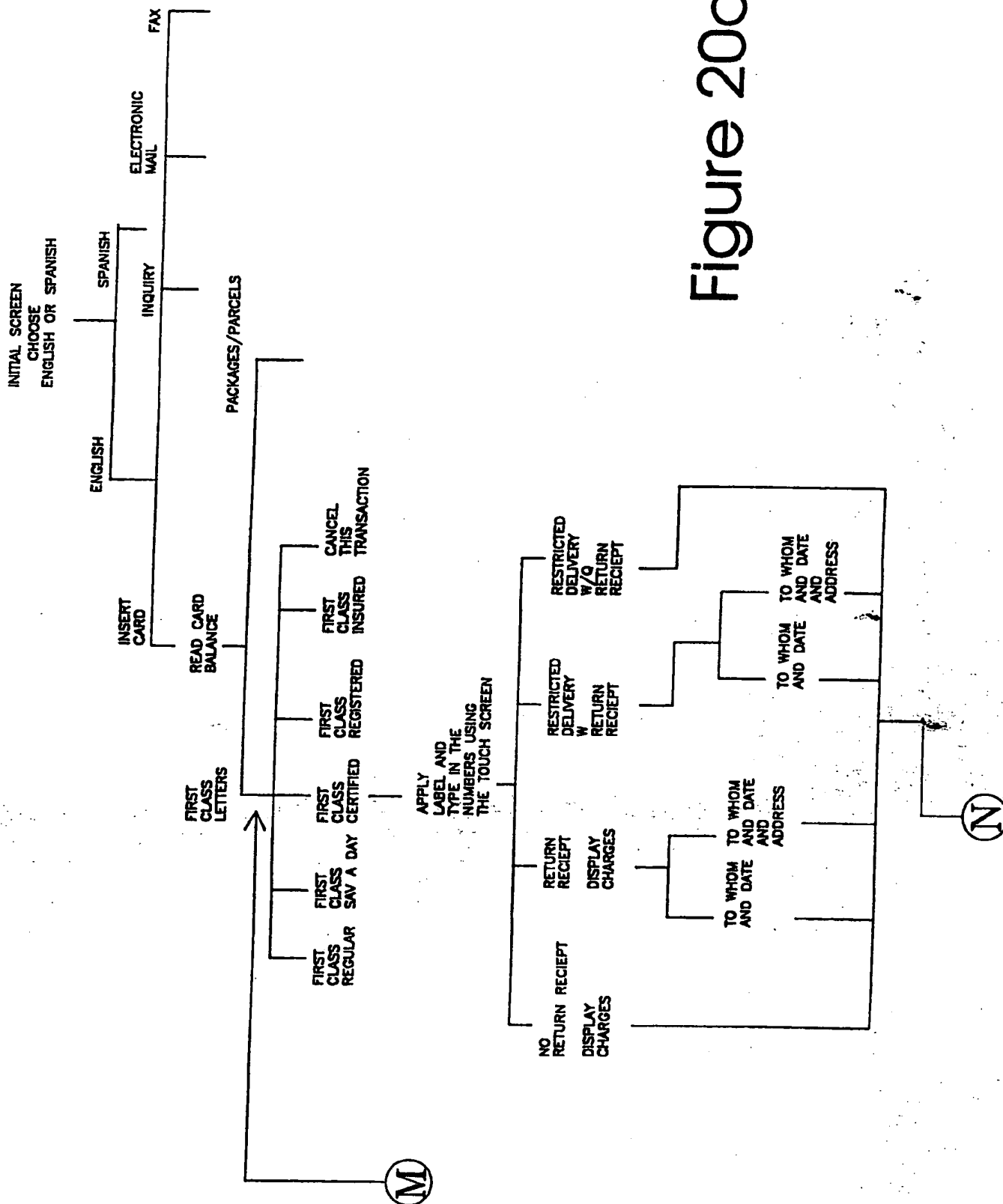


Figure 20a

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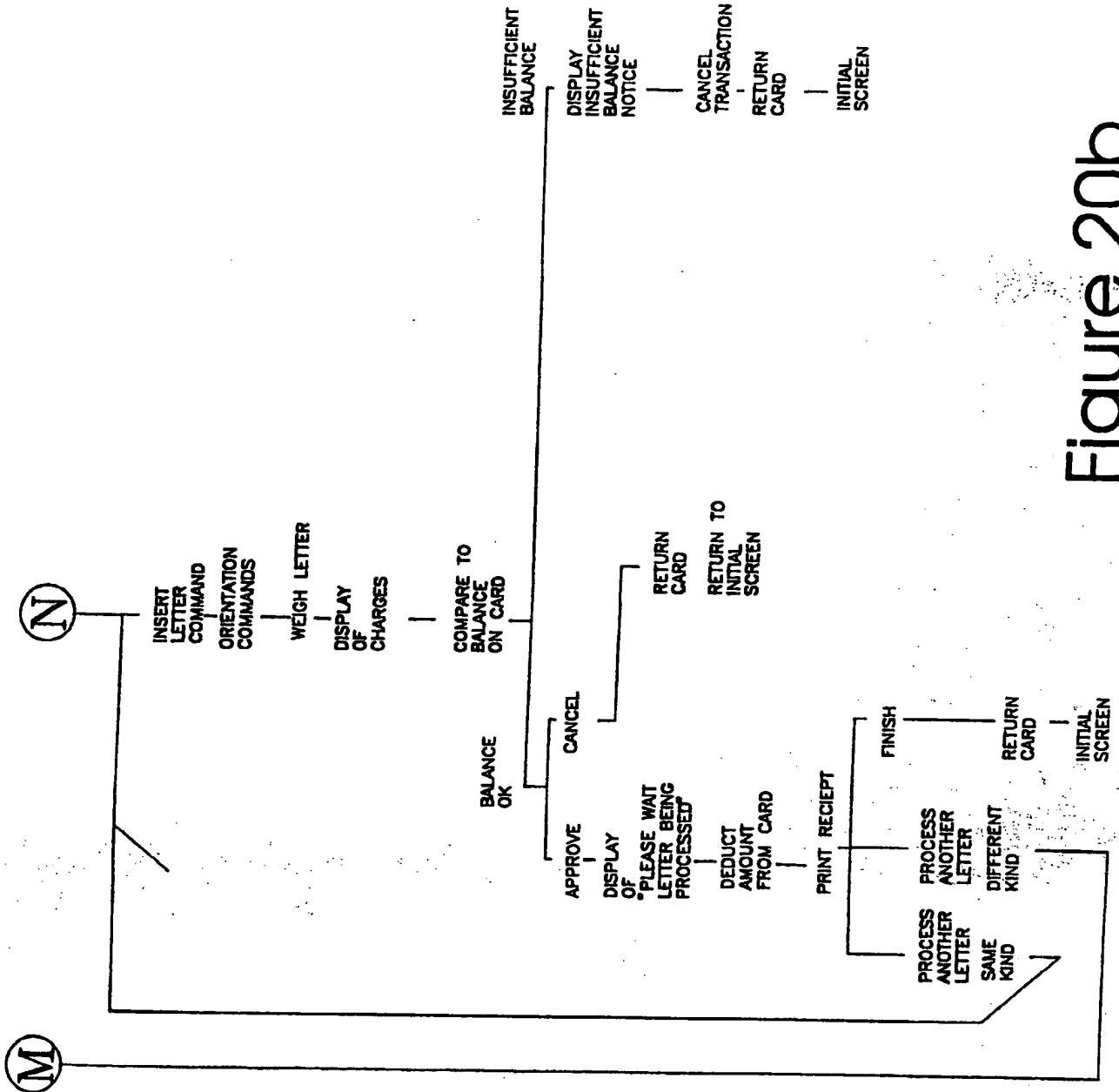


Figure 20b

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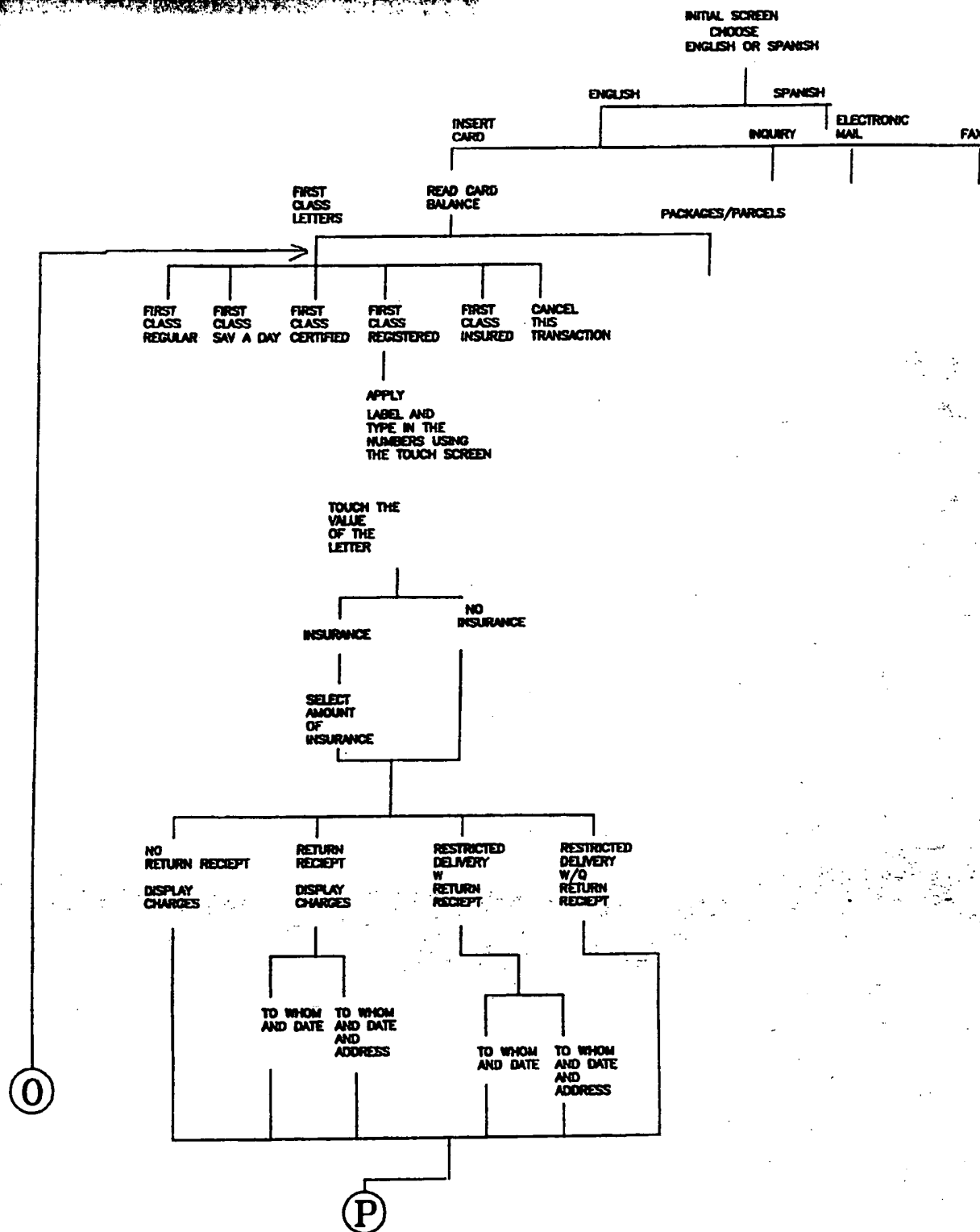


Figure 21a

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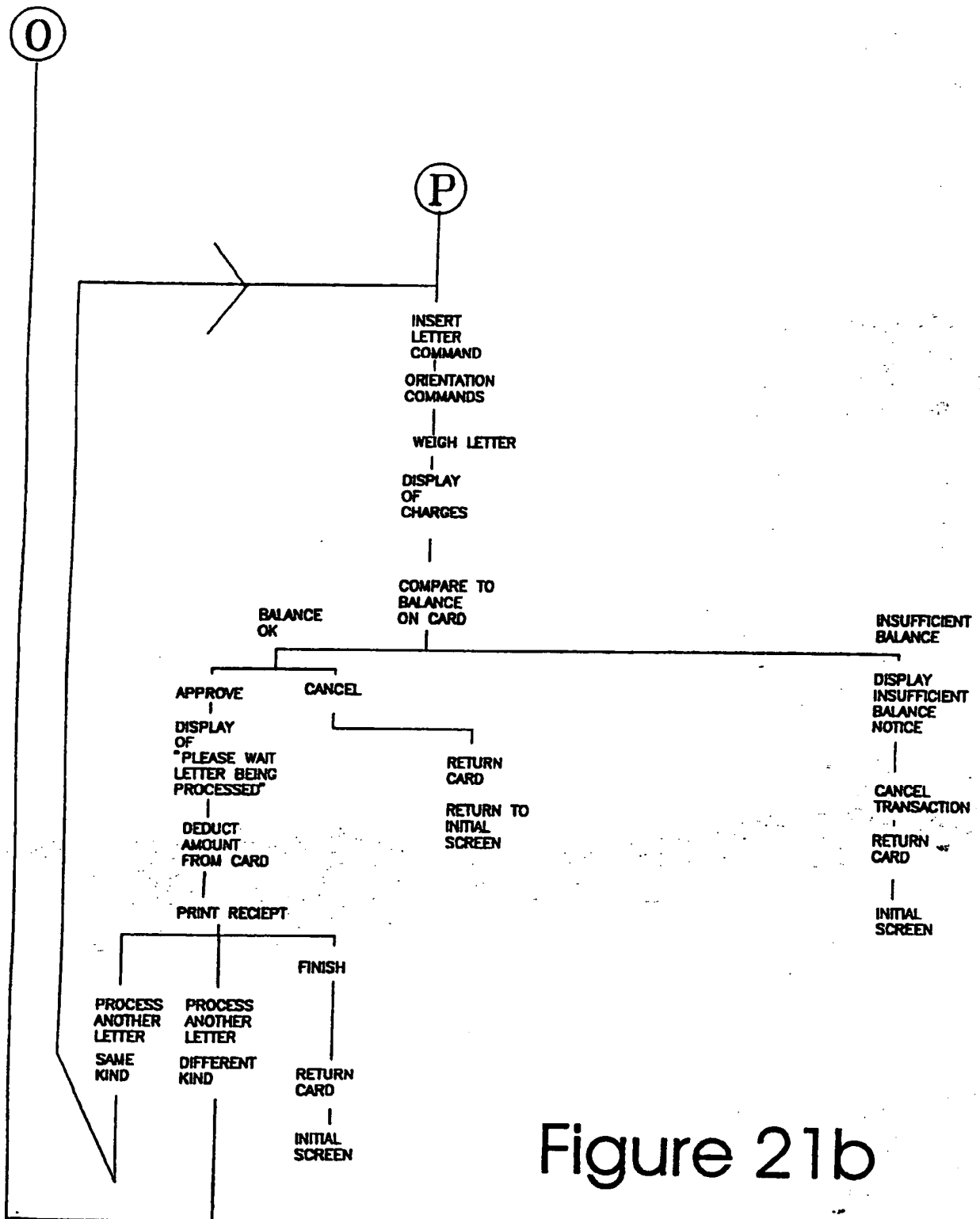


Figure 21b

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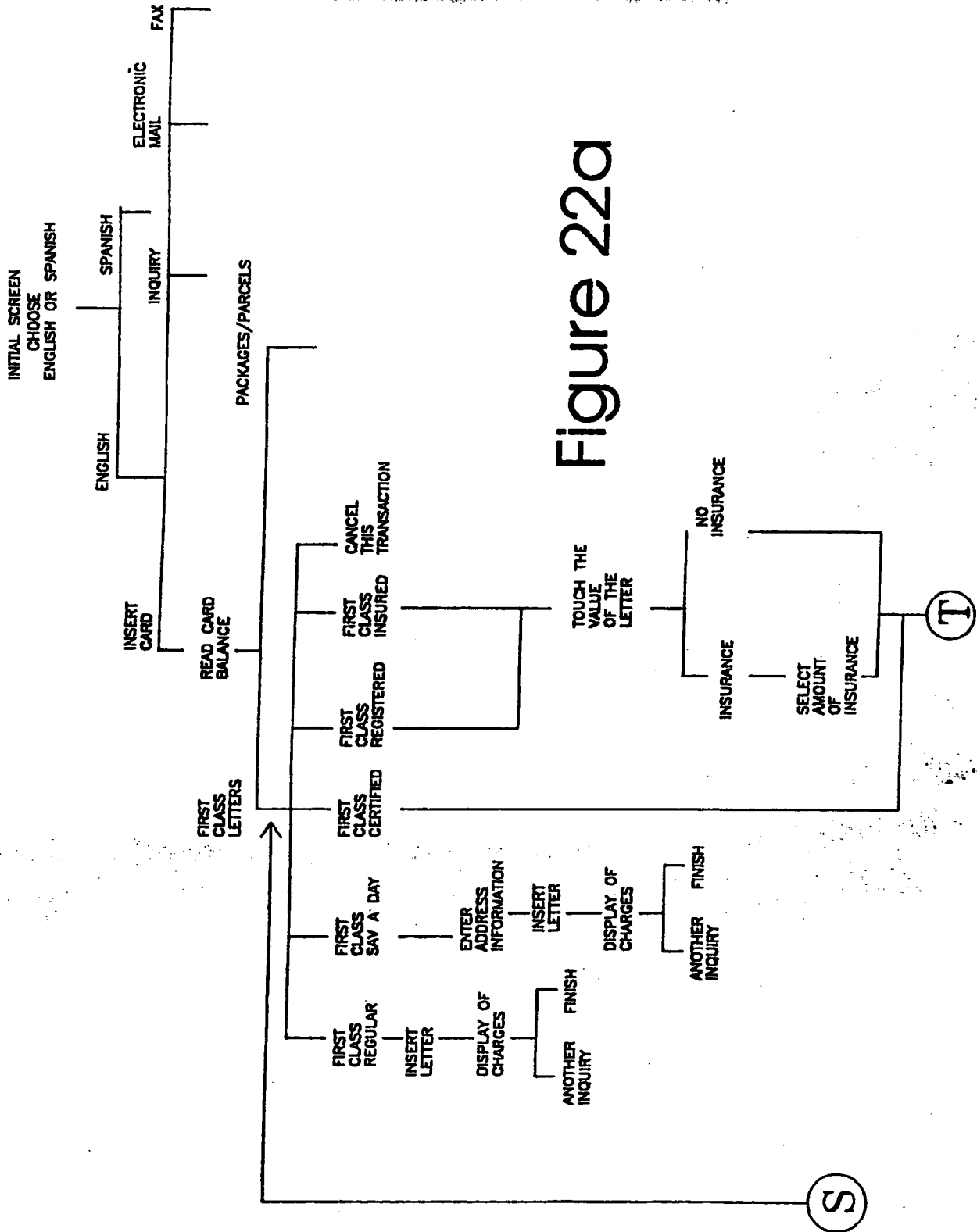


Figure 22a

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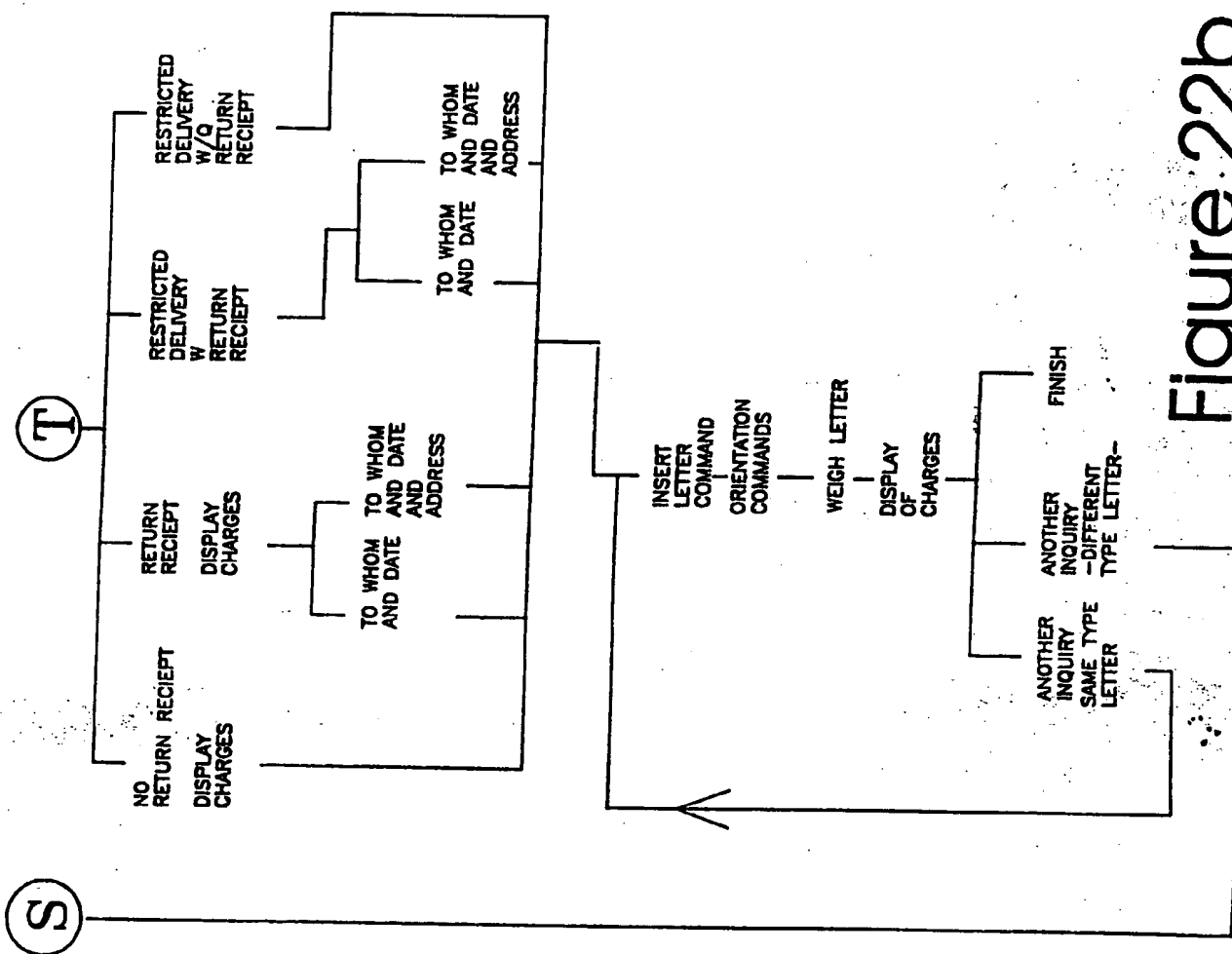
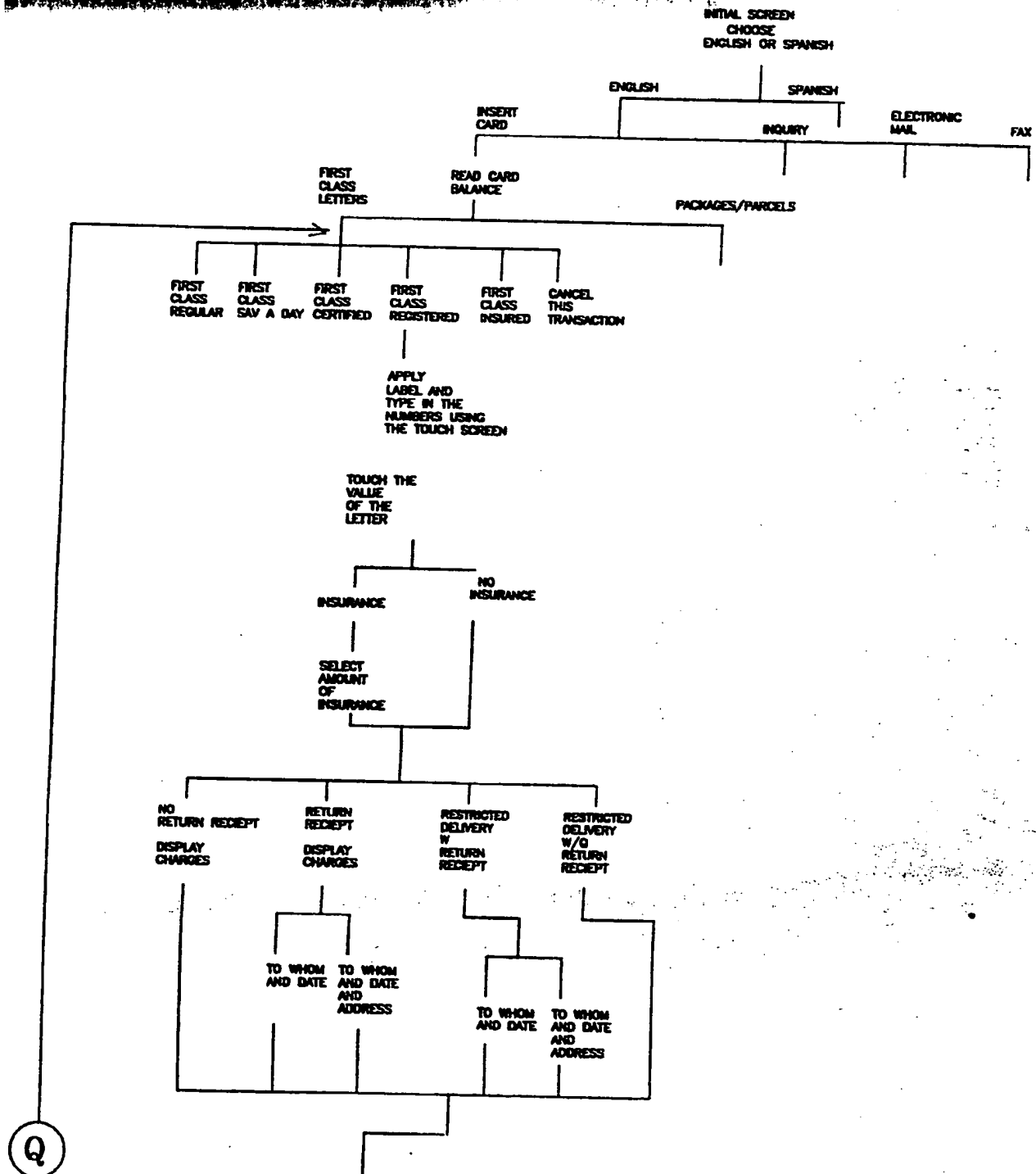
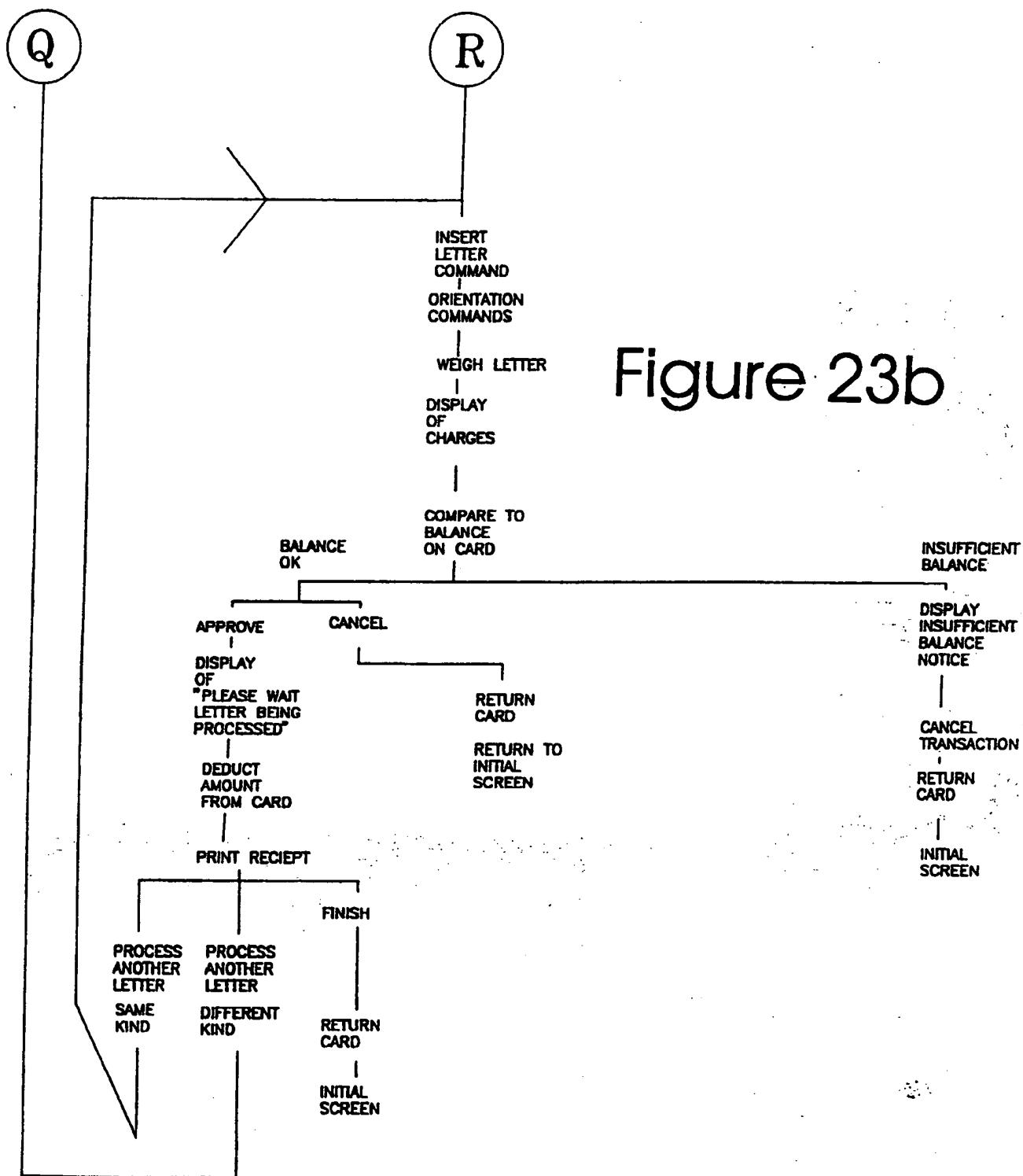


Figure 22b

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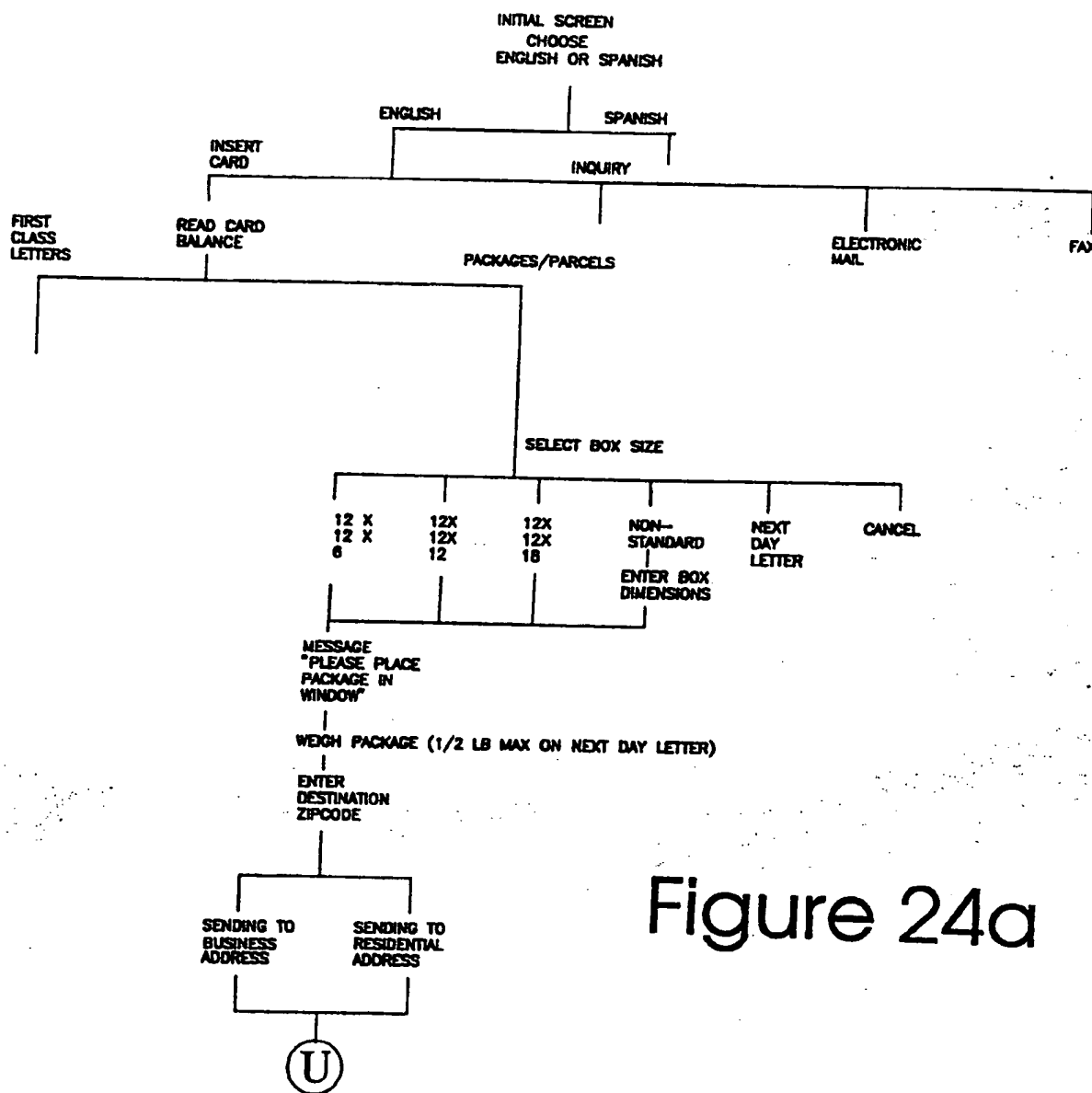


Figure 24a

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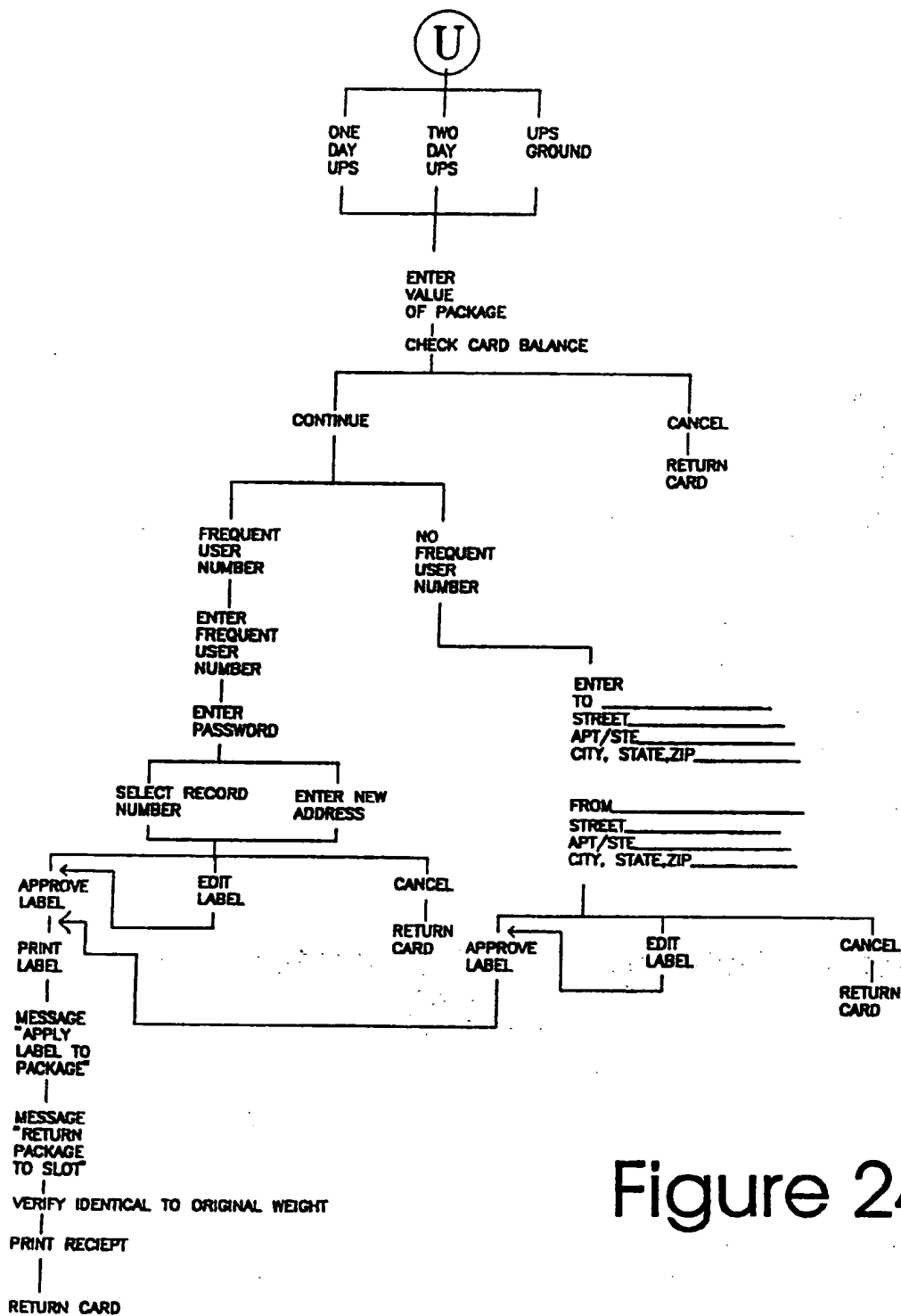


Figure 24b

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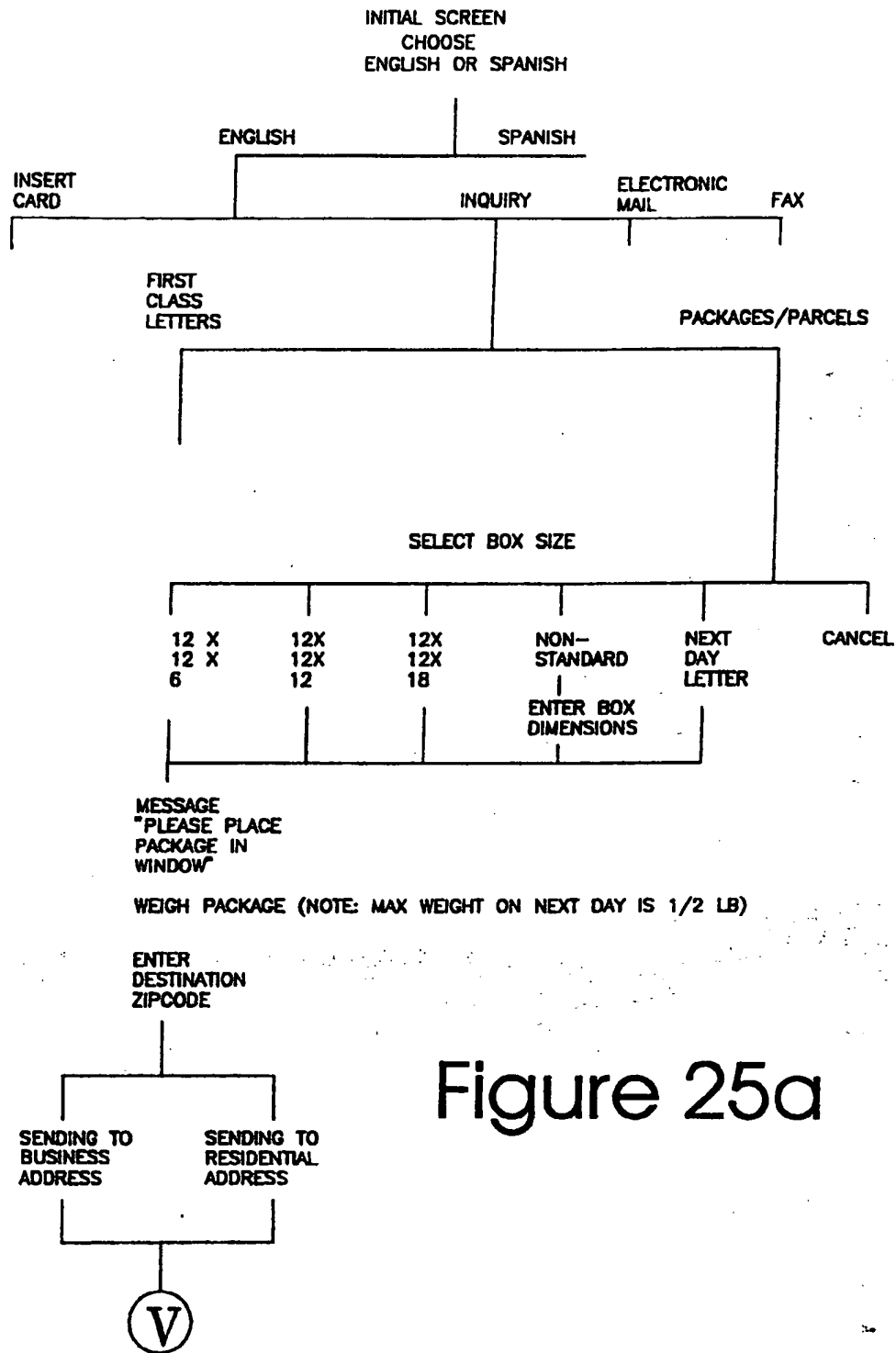


Figure 25a

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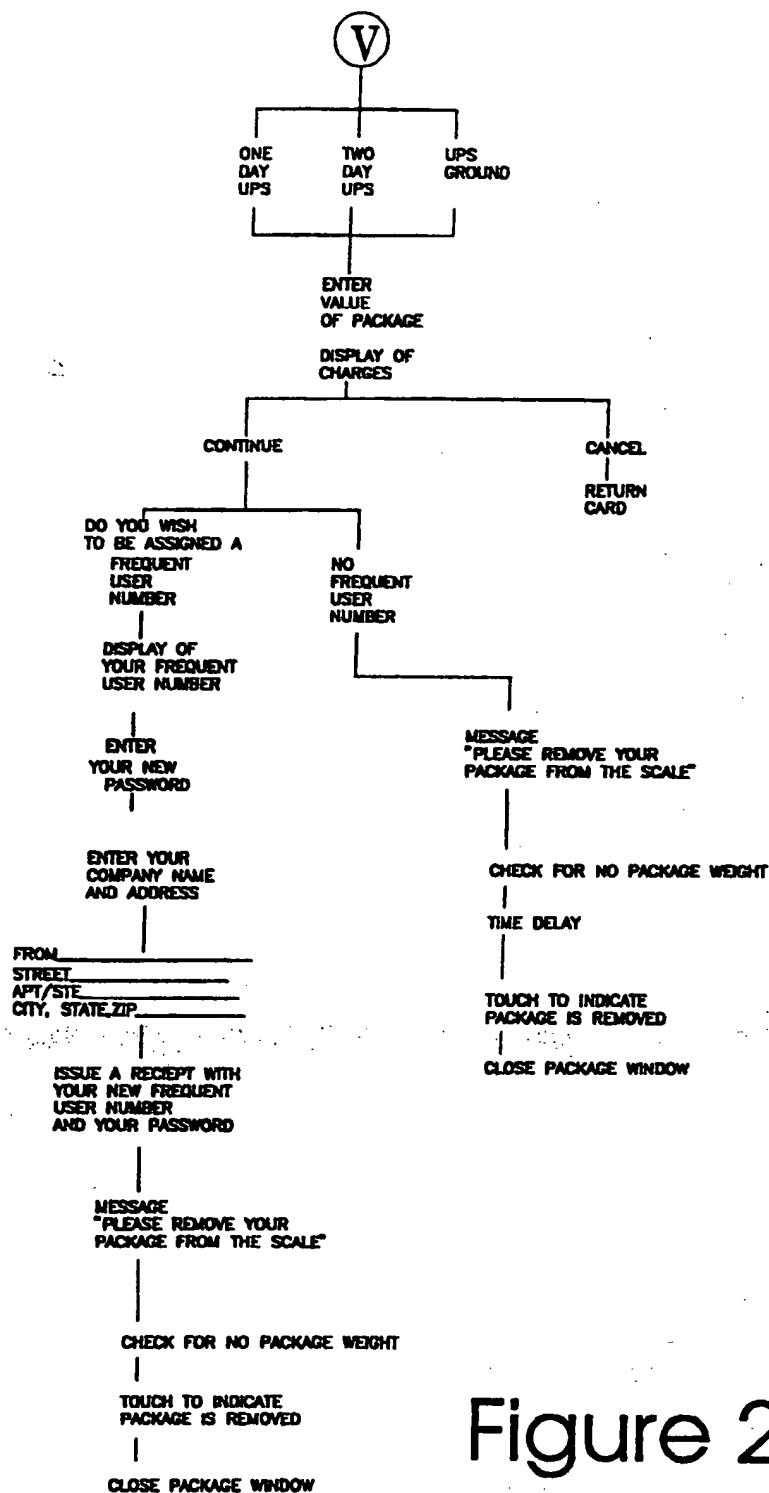


Figure 25b

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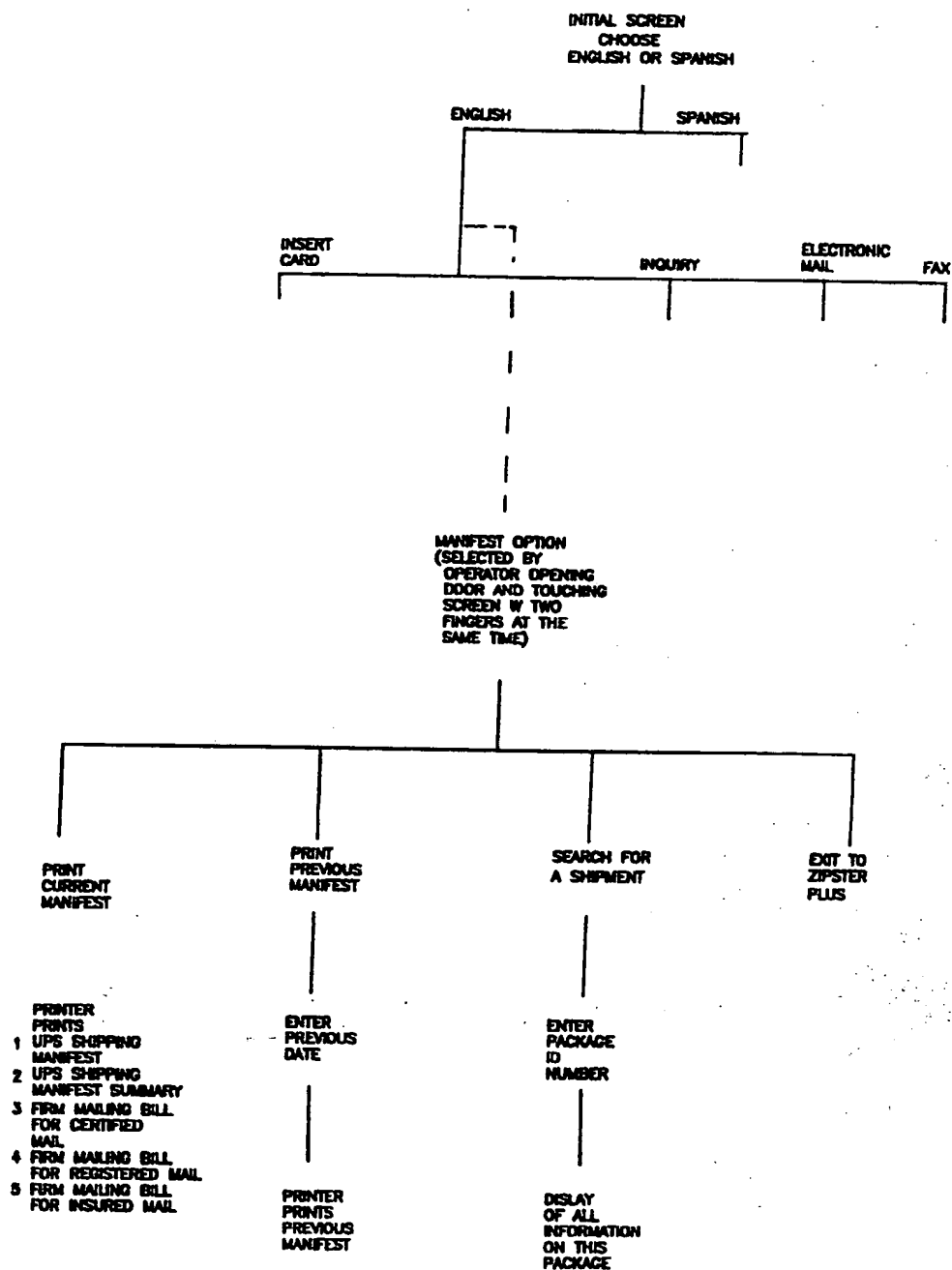


Figure 26

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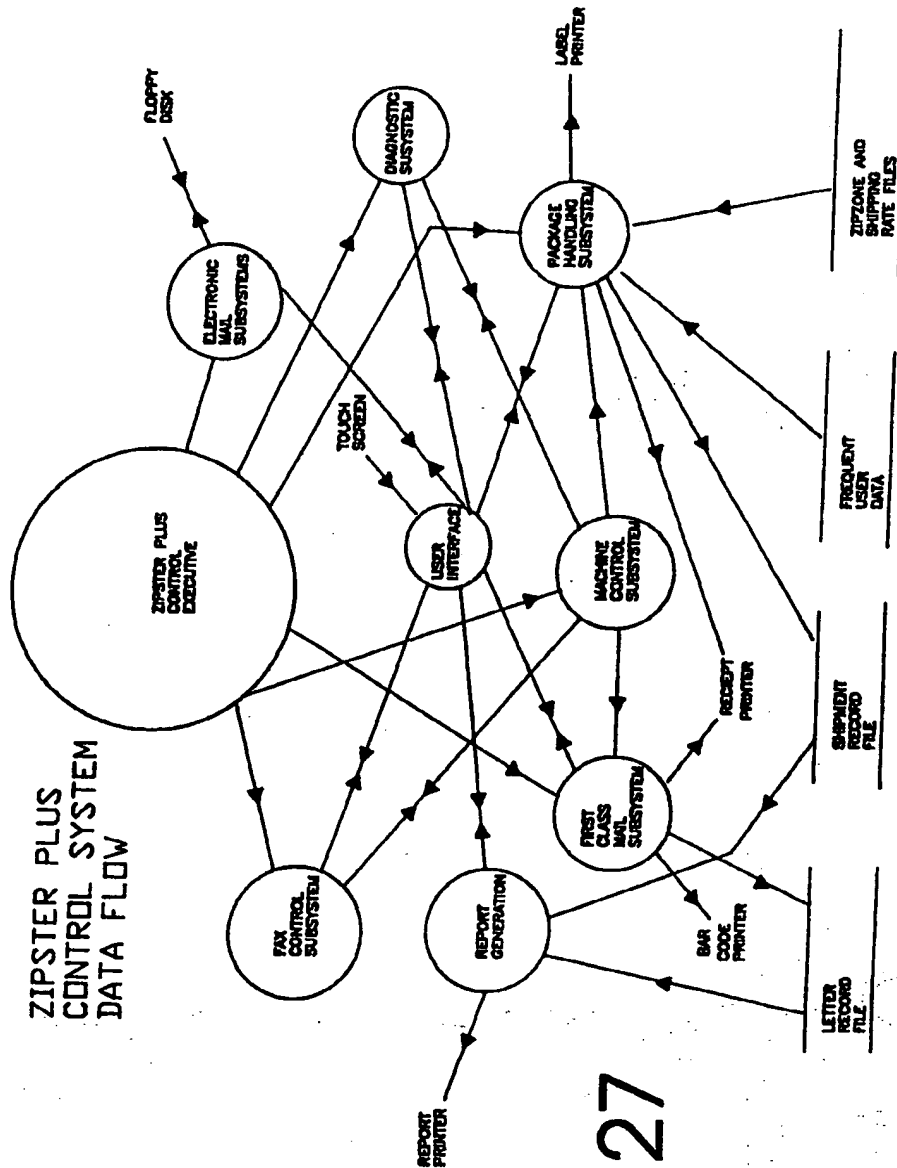


Figure 27

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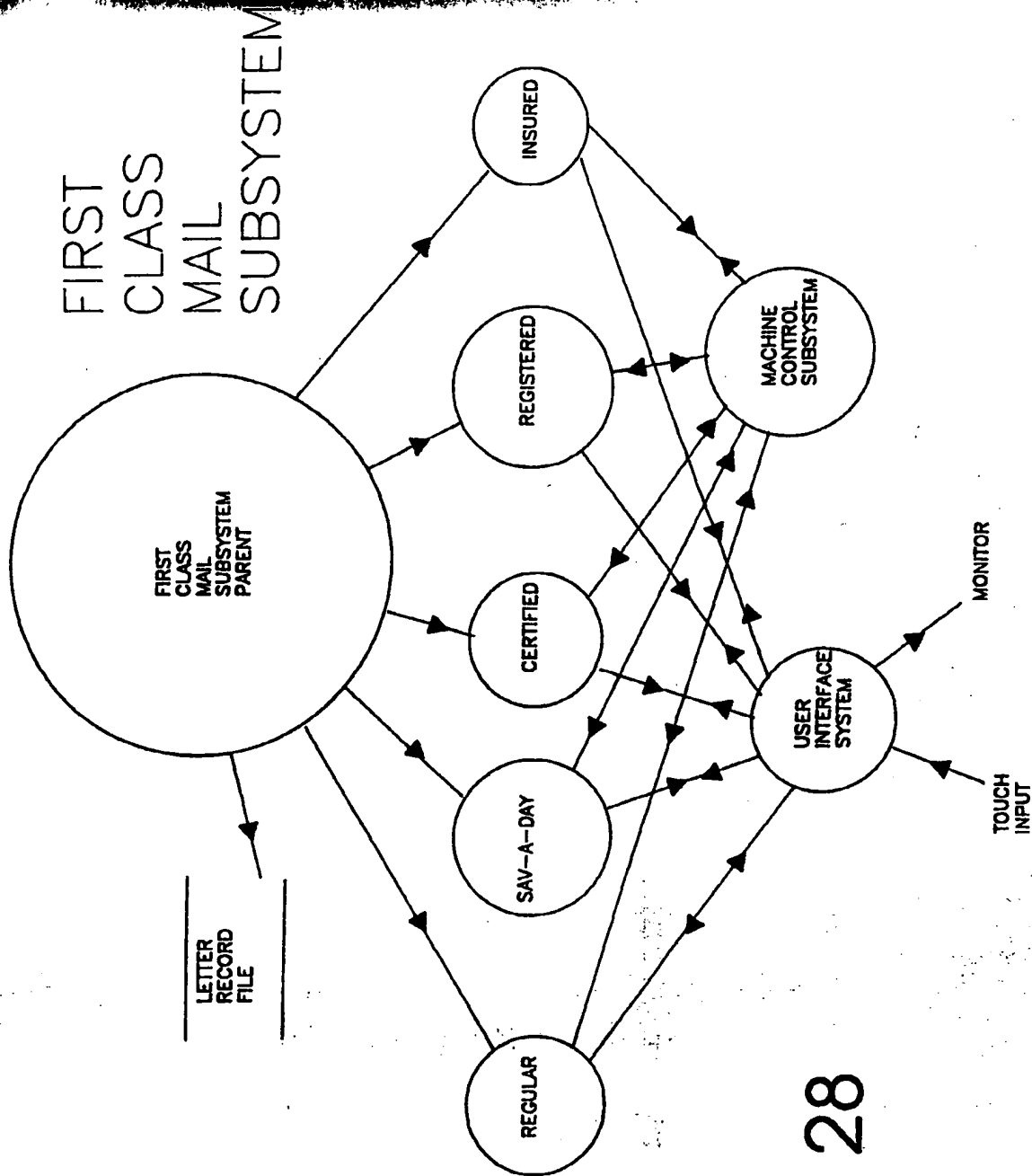


Figure 28

REPORT
GENERATION
SUBSYSTEM

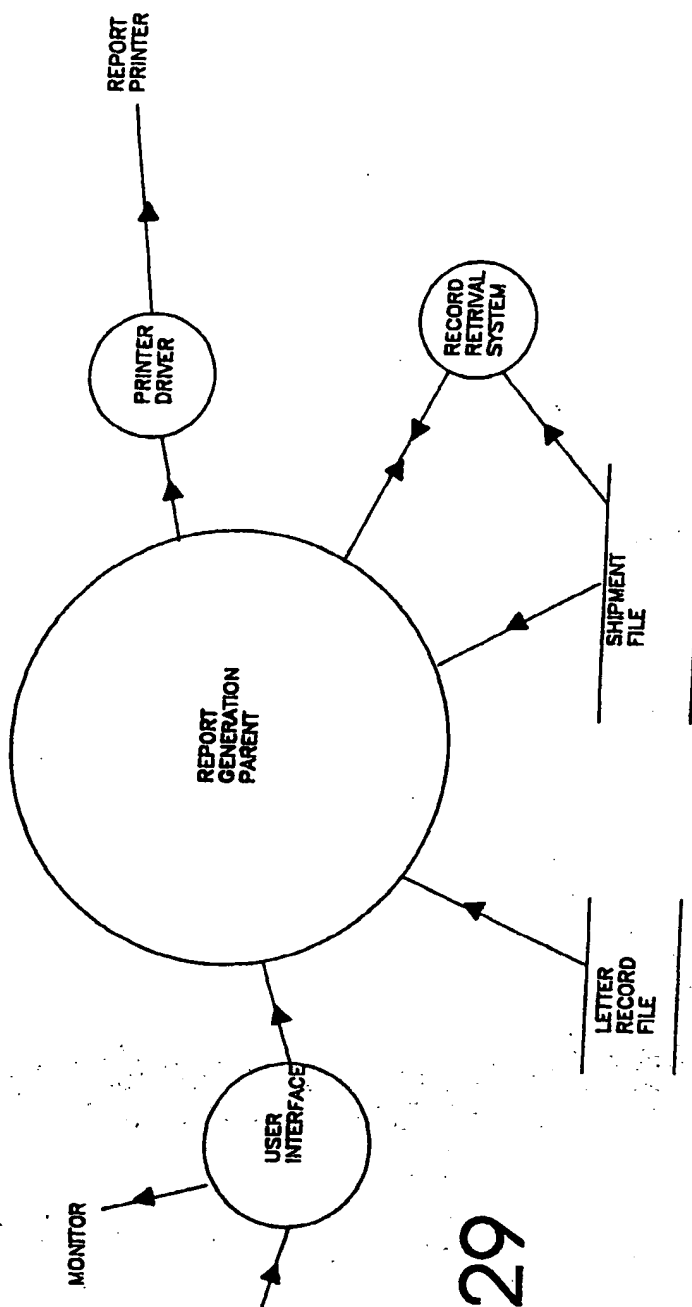


Figure 29

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PACKAGE
HANDLING
SUBSYSTEM

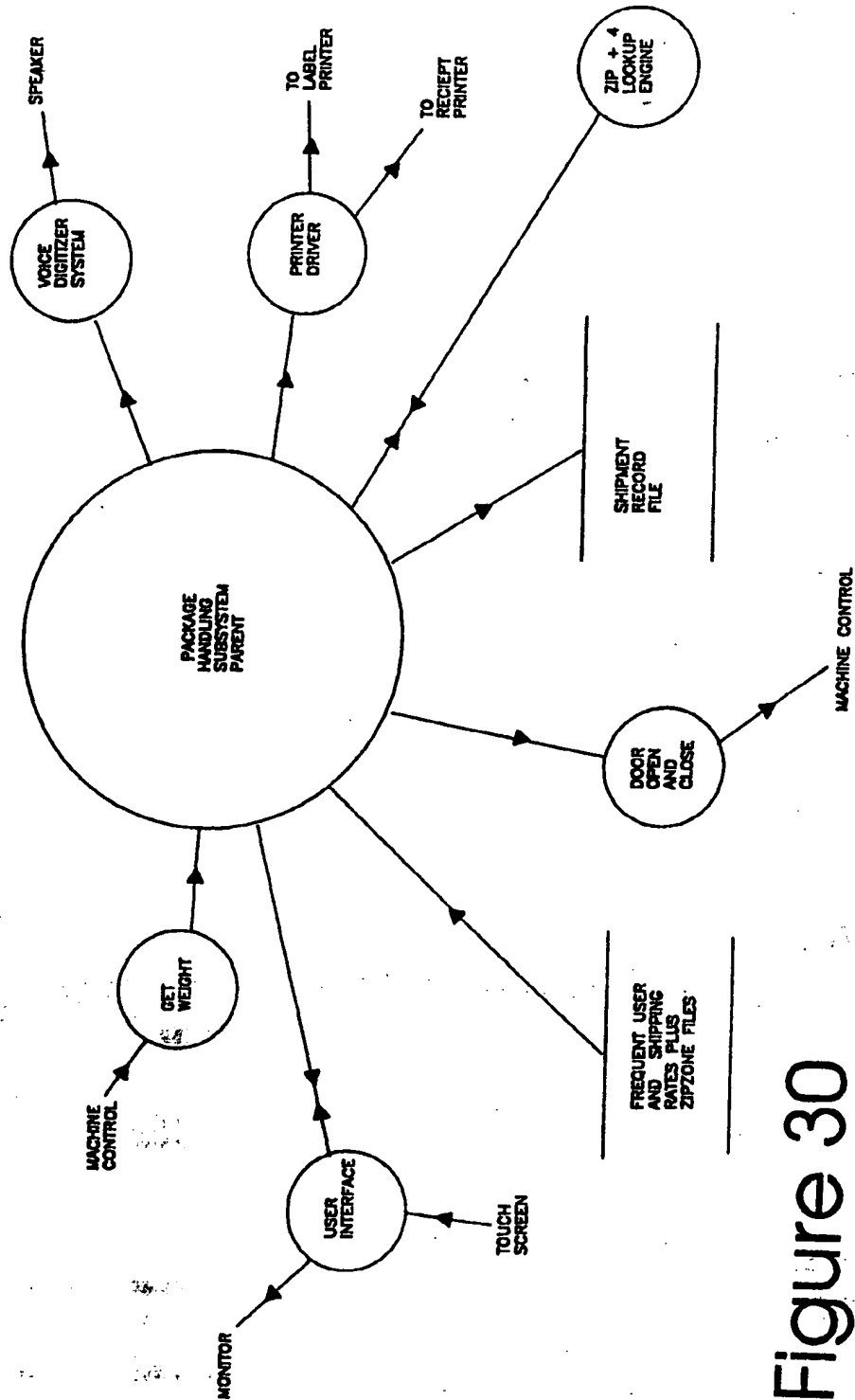


Figure 30

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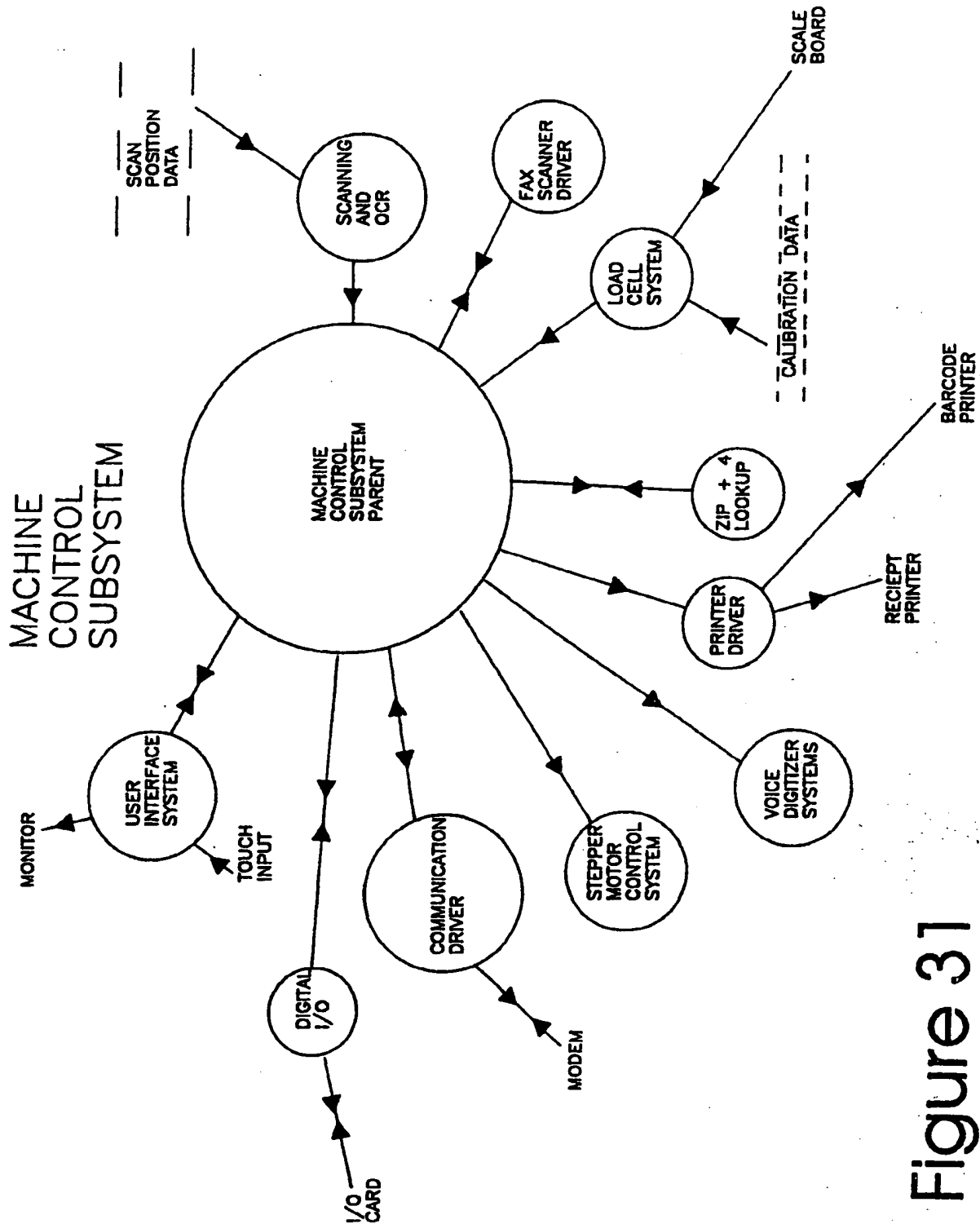


Figure 31

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US92/02510

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *

As disclosed by International Patent Classification (IPC) or to both National Classification and IPC

IPC(5): G07B 17/00

US CL : 364/478

II. FIELDS SEARCHED

Minimum Documentation Searched ⁷

Classification System

Classification Symbols

U.S.

364/478, 464.02; 235/381

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched *

III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹

Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	US, A, 4,024,380 (GUNN) 17 May 1977, See figure 6c, and columns 1-3.	1
Y	US, A, 4,598,810 (SHORE ET AL.) 08 July 1986, See column 1 objects of the invention.	1
Y	US, A, 4,803,348 (LOHREY ET AL.) 07 February 1989, See claim 26.	1
X	US, A, 4,825,053 (CAILLE) 25 April 1989, See column 4, lines 18-54.	1
X	US, A, 4,900,905 (PUSIC) 13 February 1990, See claims 1, 7, 11 and figure 2.	1
Y	US, A, 4,940,887 (SHENG-JUNG) 10 July 1990, See summary and column 5, lines 16-26.	1
X,P	US, A, 5,025,386 (PUSIC) 18 June 1991, See abstract and claims 1, 7, 12, 15).	1
Y,P	US, A, 5,065,000 (PUSIC) 12 November 1991, See invention summary.	1

* Special categories of cited documents: ¹⁰

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search

22 JUNE 1992

International Searching Authority

ISA/US

Date of Mailing of this International Search Report

28 JUL 1992

Signature of Authorized Officer

PAUL P. GORDON

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